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Extended studies of interspecific relationships of *Daucus* (Apiaceae) using DNA sequences from ten nuclear orthologs

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**Extended studies of interspecific relationships of *Daucus* (Apiaceae) using
DNA sequences from ten nuclear orthologs**

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MARTÍNEZ FLORES *ET AL.*: INTERSPECIFIC RELATIONSHIPS OF *DAUCUS*

Daucus traditionally has been estimated to contain 21–25 species, but a recent study expanded the genus to contain about 40 species. The present study uses ten nuclear orthologs to examine 125 accessions, including 40 collections of eleven species newly examined with nuclear orthologs: *D. annuus*, *D. arcanus*, *D. decipiens*, *D. durieua*, *D. edulis*, *D. gracilis*, *D. minusculus*, *D. montanus*, *D. pumilus*, *D. setifolius*, and *D. tenuissimus*. As in prior nuclear ortholog studies, *Daucus* resolves into two well-defined clades, and groups different accessions of species together. Maximum likelihood and maximum parsimony analyses provide concordant results but SVD quartets (a species tree approach) has many areas of disagreement of species within these two major clades. Maximum likelihood and maximum parsimony analyses resolve *Daucus montanus* (hexaploid) as an allopolyploid between *D. pusillus* (diploid) and *D. glochidiatus* (tetraploid) and SVD quartets as an allopolyploid between *D. glochidiatus* and an unknown *Daucus* species. We propose the new combination *Daucus junceus* (*Durieua juncea*) for a neglected species endemic to SW Iberian Peninsula often referred to as *D. setifolius*, and place *D. arcanus* in synonymy with *D. pusillus*. Three lectotypes are also designated.

ADDITIONAL KEYWORDS: Carrot species – Daucinae – germplasm – nomenclature – phylogeny – taxonomy – typification.

INTRODUCTION

The latest comprehensive taxonomic monograph of *Daucus* L. by Sáenz (1981) recognized 21 species; Rubatzky, Quirós & Simon (1999) later estimated 25 species. Recent morphological and molecular studies using a variety of plastid and nuclear DNA sequences have been drastically changing our understanding of the species boundaries (Arbizu *et al.*, 2014b, 2016; Spooner *et al.*, 2014), and ingroup and outgroup relationships of *Daucus* (e.g., Spalik & Downie, 2007; Arbizu *et al.*, 2014a; Banasiak *et al.*, 2016; Spooner *et al.*, 2017). Banasiak *et al.* (2016) used DNA sequences from nuclear ribosomal ITS and the three plastid markers (*rps16* intron, *rpoC1* intron, and *rpoB-trnC* intergenic spacer) to redefine and expand the genus *Daucus* to include the following genera and species into its synonymy: *Agrocharis* Hochst. (4 species), *Melanoselinum* Hoffm. (1 species), *Monizia* Lowe (1 species), *Pachyctenium* Maire & Pamp. (1 species), *Pseudorlaya* (Murb.) Murb. (2 species), *Rouya* Coincy (1 species), *Tornabenea* Parl. (6 species), *Athamanta della-cellae* Asch. & Barbey ex E.A.Durand & Barratte, and *Cryptotaenia elegans* Webb ex Bolle. They made the relevant nomenclatural transfers into *Daucus*, expanding the genus to contain about 40 species. In addition, they divided *Daucus* into four sections, three of which (section *Daucus*, section *Melanoselinum* (Hoffm.) Spalik *et al.*, section *Anisactis* DC) we examine here, not examining section *Agrocharis* (Hochst) Spalik *et al.* that is sister to the sections above and comprised of the former genus *Agrocharis* Hochst. This expansion of *Daucus* and new sectional classification renders *Daucus* quite difficult to characterize morphologically, and was based solely on molecular data.

Arbizu *et al.* (2014a) identified 94 nuclear orthologs in *Daucus*, constructed a phylogenetic tree with these, and determined ten of them to

provide essentially the same result as all 94, paving the way for additional cost-effective nuclear ortholog studies in carrot. These ten nuclear orthologs were then successfully used in a focused study of the species boundaries of the *D. guttatus* Sibth. & Sm. complex (Arbizu *et al.*, 2016), which, in concert with data from type specimens (Martínez-Flores *et al.*, 2016), redefined the species boundaries and nomenclature of this group. The focus of the present study is to expand further these studies by adding 40 accessions of taxa from eleven species and from areas not examined with these ten nuclear orthologs. We provide suggestions on further taxonomic research on *Daucus*, and new taxonomic decisions and synonymies (below).

MATERIALS AND METHODS

ACCESSIONS EXAMINED

Previously sequenced amplicons were obtained from Arbizu *et al.* (2014a, 2016), and are listed in those publications. The 40 new accessions (Table 1) were obtained from (1) the Agrocampus Ouest – IRHS, France, (2) the Warwick Crop Centre, UK, and (3) an expedition in Spain in 2016. Newly examined taxa are *D. annuus* (Bég.) Wojew. *et al.* = *Tornabenea annua* Bég., *D. arcanus* García Martín & Silvestre, *D. decipiens* (Schrad. & J.C.Wendl.) Spalik *et al.* = *Melanoselinum decipiens* (Schrad. & J.C.Wendl.) Hoffm., *D. durieua* Lange, *D. edulis* (Lowe) Wojew. *et al.* = *Monizia edulis* Lowe, *D. gracilis* Steinh., *D. minusculus* Pau ex Font Quer = *Pseudorlaya minuscula* (Pau ex Font Quer) M.Lainz, *D. montanus* Humb. & Bonpl. ex Schult., *D. pumilus* (L.) Hoffmanns. & Link = *Pseudorlaya pumila* (L.) Grande, *D. setifolius* Desf., and *D. tenuissimus* (A.Chev.) Spalik *et al.* = *Tornabenea tenuissima* (A.Chev.) A.Hansen & Sunding. We lack vouchers for three accessions that grew as young plants sufficient to obtain DNA, but failed to grow to flowering stage as is typical for some

species of *Daucus* that are biennials or have other problems flowering in cultivation.

CHROMOSOME COUNTS

We obtained chromosome counts of all the species examined in this study from the literature using the Missouri Botanical Garden Index to Plant Chromosome Numbers (IPCN; Goldblatt & Johnson, 1979--; (<https://www.tropicos.org/Project/IPCN>) (Table 2) and other sources from the *Daucus* literature. We found chromosome number references for all examined species except for *Daucus bicolor*, *Daucus conchitae* and *Daucus gracilis*.

DNA EXTRACTION AND SEQUENCE GENERATION

New accessions were grown a greenhouse at the University of Wisconsin-Madison, tissue harvested and freeze-dried leaves, and DNA extracted with CTAB (Doyle & Doyle, 1990). For markers dc10366, dc10966, dc15347, dc16308, dc16577, dc3374, dc3902, and dc35097, 200 ng of DNA was amplified in 20 µL volume containing 1X Buffer, 1.5 mM MgCl₂, 0.2 mM dNTP (Promega Corporation, USA), 0.2 µM each forward and reverse primer, and 1 U taq (GoTaq®, Promega Corporation, USA) with the following program steps of 94°C for 5 minutes, 35 cycles of 94°C for 30 seconds, 55°C for 1 minute, and 72°C for 2 minutes, followed by 72°C for 10 minutes. For markers dc16645 and dc32914, and any unamplified product from the previous eight markers, the magnesium concentration was doubled to 3 mM and the annealing step lowered from 55°C to 50°C. The forward and reverse strands were Sanger sequenced for each amplicon at the Biotechnology Center of the University of Wisconsin-Madison. Amplicons SNP differences or with an insertion or deletion, discovered during Sanger sequencing, were further processed with SSCP following Cai et al. (2012), using the MDE gel solution and 72 hr run times.

PHYLOGENETIC ANALYSES

We deposited all sequences in GenBank (Supplementary file 1); sequences were assembled with PreGap4 and Gap4 (Staden, 1996), aligned with MUSCLE version 3.8.31 (Edgar, 2004), and alignments corrected in Mesquite version 3.31 (Maddison & Maddison, 2017). A major analytical problem, most critical for analyses with multiple and highly unlinked nuclear orthologs is how to align allelic data across markers data in concatenated analyses. There is no logical solution to concatenate such widely dispersed ortholog data unambiguously. We addressed this challenge by separating the alleles into two randomly chosen sets in concatenated matrices and examining each of these two datasets separately. As detailed below, maximum likelihood (ML) and maximum parsimony (MP) results were unambiguous in showing that the two analyses positioned all 124 accessions in nearly equal positions on the tree, except for the allopolyploid *Daucus montanus*, that in one set resolved with *D. durieua* and in the other set with *D. glochidiatus*. Based on this result we analyzed each of the 20 ortholog trees separately (10 for set A and 10 for set B) and these individual analyses clearly showed the orthologs supporting an allopolyploid origin from *D. durieua* and *D. glochidiatus*. Only when *D. montanus* is included do we find internal conflict of A and B allele sets.

The aligned file A (see below) is deposited in TreeBASE (submission ID 32618). We rooted our trees on *Athamanta sicula* based on Downie, Katz-Downie & Spalik (2000). Maximum parsimony analysis was conducted in PAUP* version 4.0a145 (Swofford, 2002). Missing data and gaps were all scored as missing data. All characters were treated as unordered and weighted equally (Fitch, 1971). The most parsimonious trees were found using a heuristic search (Farris, 1970) by generating 100,000 random taxon addition sequence replicates using tree-bisection reconnection (TBR) and holding one tree for each replicate. Then, we ran a final heuristic search of the most equally parsimonious trees from this analysis using TBR and MULPARS. Bootstrap values

(Felsenstein, 1985) for the clades were estimated using 1,000 replicates with a heuristic search, TBR and MULPARS, setting MAXTREES to 1000.

Maximum likelihood analysis was conducted via the CIPRES (Miller, Pfeiffer & Schwartz, 2010) portal at the San Diego Supercomputer Center (<http://www.phylo.org>) with the GTR + G nucleotide substitution model using RAxML version 8.2.4 (Stamatakis, 2014). The most common model of evolution for DNA analysis is general time-reversible (GTR) (Summer *et al.*, 2012) being the main reason only GTR-based models are implemented in RAxML (Stamatakis, 2014). We obtained the best-scoring ML tree from 100 independent ML tree searches, and then 1,000 nonparametric bootstrap inferences were performed with the same program. As in MP, we rooted our tree on *Athamanta sicula*.

We also conducted a singular-value decomposition (SVD) quartets analysis using the multispecies coalescent option (Chifman & Kubatko, 2014, 2015) (a species tree approach) with 100 bootstrap replicates, also using PAUP* version 4.0a131.

RESULTS

MAXIMUM PARSIMONY

The number of alleles for the ten nuclear orthologs of our new data varied from 1-2. Some failed to amplify, with an average of 9.2% missing data across all markers (Supplementary file 2). Tree statistics for the four main analyses under MP (A allele and B allele, each with and without *D. montanus*) are presented in Supplementary file 3. The MP A (Supplementary file 4) and B set (Fig. 1) trees were extremely similar, except for *D. montanus* that in one set resolved in a clade with *D. pusillus* Michx., and in another with *D. glochidiatus* (Labill.) Fisch., C.A.Mey. & Avé-Lall. Hence, we examined each of the ten genes separately for each set, with and without *D. montanus* (20 analyses in total), and found that the alleles of *D. montanus* resolved into

different species (Supplementary file 5; Table 3), supporting an allopolyploid origin between *D. pusillus* and *D. glochidiatus*.

Figure 1 is of the B set run without *D. montanus*, which was then added manually relative to *D. pusillus* and *D. glochidiatus*. Relative to prior studies using these markers, *Daucus* resolves into two well-defined clades A and B, and the species with $2n=18$ chromosomes into subclade A' (except for *D. tenuissimus*, $2n = 16$). The newly examined taxa resolve in clade B as *D. arcanus* sister to *D. pusillus* and *D. durieua* sister to *D. glochidiatus*. In clade A, *D. annuus*, *D. gracilis*, and *D. tenuissimus* resolve into clade A'; *D. decipiens*, *D. edulis*, *D. minusculus*, and *D. pumilus* (along with previously examined *D. rouyi*) sister to clade A'; and *D. setifolius* sister to *D. crinitus*. *Daucus montanus* (a hexaploid) is an apparent allopolyploid between *D. pusillus* (diploid) and *D. glochidiatus* (tetraploid). These results partly match the new sectional classification of Banasiak et al. (2016) except that the Macronesian endemic species *D. decipiens* and *D. edulis* are embedded in clade A (their section *Daucus*), not as a separate basal clade to clade A that they recognize as section *Melanoselinum*. The remaining species of clade B match the placement of their section *Anisactis*, yet not with the same cladistic structure within these clades.

Figure 1 shows the chromosome numbers (Table 2) supporting clades. In some cases, there is chromosome number support for clades, for example *Daucus arcanus* and *D. pusillus* or *D. aureus* and *D. muricatus*. In many other cases, there is poor association of chromosome numbers and clades.

MAXIMUM LIKELIHOOD

The ML tree of allele set B is presented in Supplementary file 6. Except for minor differences in the topology of some duplicate accessions within species exhibiting low bootstrap values in both ML and MP analyses (e.g., *D. conchitae*, *D. guttatus*), and in the topology of *D. aureus* and *D. muricatus*,

there are no substantive differences between the ML and MP analyses. In the MP analysis *D. aureus* and *D. muricatus* are sister taxa with moderate (77%) bootstrap support, but in the ML analysis *D. muricatus* is sister to a clade containing *D. aureus*, other members of the A' clade, *D. rouyi*, *D. minusculus* and *D. pumilus*.

SVD QUARTETS MULTISPECIES COALESCENT ANALYSIS

As molecular systematics progressed, multiple datasets using different genes or gene regions for the same accessions became common. It was soon discovered that the results typically showed some incongruence, and were sometimes very incongruent (Wendel & Doyle, 1998; Rokas *et al.*, 2003). A number of solutions were advanced for this problem, one a total evidence analysis of a single concatenated dataset, which essentially joins all of the independent data together as a single locus to resemble one large supergene (Springer & Gatesy, 2015) as we perform here with ML and MP. Others, however, argued that incongruence was expected with a history of incomplete lineage sorting (e.g., Linz, Radtke & Haeseler, 2007) and that the data should be analyzed by multispecies coalescent procedures that took this into account (e.g., Edwards *et al.*, 2016). Which procedure is more appropriate, or whether different procedures are appropriate for different groups is still a matter of debate and we performed both here.

Figure 2 shows the SVD quartets multispecies coalescent results of allele set B run without *D. montanus*. Supplementary file 7 shows the allele set A and B trees with and without *D. montanus* and allele set B with *D. montanus*. Figure 2 shows many points of concordance and discordance with the ML and MP analysis (these two treated here as a single largely concordant result). While SVD maintains the same major clades (A, A', B) there many areas of disagreement of species within these two clades. For example, ML and MP resolve *Daucus montanus* as an allopolyploid between *D. pusillus* and *D.*

glochidiatus, while SVD supports *D. glochidiatus* as one parent, but the other allele is sister to *D. pusillus*, *D. bicolor*, *D. guttatus*, and *D. glochidiatus*. In clade A, ML and MP resolve *D. tenuisectus* as sister to *D. crinitus*, *D. junceus* and *D. setifolius*, but SVD as sister to all of clade A. Similar discordances occur between analyses of *D. decipiens* + *D. edulis* and *D. aureus* and *D. muricatus*. In clade B, between analyses discordances also occur with *D. pusillus* + *D. arcanus* and *D. durieua* + *glochidiatus* and indeed other groups of species. In addition, bootstrap support values throughout *Daucus* are in general reduced relative to ML and MP.

DISCUSSION

The genus *Daucus* has been the focus of numerous phylogenetic studies. Most of these have been based on one or few DNA regions, mainly nuclear internal transcribed spacer regions (nrITS) (Spalik & Downie, 2007; Spalik *et al.*, 2010; Lee & Park, 2014; Banasiak *et al.*, 2016) which produced trees greatly helping to redefine relationships in *Daucus* and outgroups but sometimes with moderate to weak support in some terminals. Recently, phylogenetic trees constructed with single-to low-copy nuclear orthologous gene sequences (Arbizu *et al.*, 2014a) have yielded phylogenies with stronger support and more consistent with morphological relationships among clades. In prior studies, incorrect identifications existed for members of the *D. guttatus* complex (including *D. bicolor* Sm., *D. broteri* Ten., *D. guttatus*, and *D. setulosus* Guss. ex DC.) which hindered the interpretation of trees based on morphology. Those misidentifications were corrected in Arbizu *et al.* (2016) and Martínez-Flores *et al.* (2016) and we here use this corrected nomenclature.

Previous studies found that members of *Daucus* (*s.l.*) are arranged into two well supported (96–100% bootstrap) clades (hereafter referred to as

clades A and B, with the species with $2n = 18$ resolving into a subclade A'). Species in clade A were sister to the 'Macaronesian endemics group', section *Melanoselinum* (Spalik & Downie, 2007; Banasiak et al., 2016) including taxa usually ascribed to the genera *Cryptotaenia* DC., *Melanoselinum* and *Monizia*. These three genera are native to the Macaronesian region and have been classified in other genera due to striking morphological traits deviating from traditionally circumscribed *Daucus* species (detailed below). Species in clade B are sister to members of *Agrocharis*, a genus native to central tropical Africa. According to Lee (2002), *Agrocharis* characters of fruit morphology (i.e., primary ridges with numerous papillate hairs, well-developed secondary ridges, and single-rowed stout spines with glochidiate apex) support a close relationship to *Daucus*, though with some striking differences (i.e., petals yellow, yellowish-greenish or dark vs. white or pinkish; and most spines of each ridge straight and retrorse) that allow easy recognition separate from *Daucus* (Martínez-Flores, 2016). *Agrocharis* species are tetraploids with $2n = 44$, a chromosome number infrequent within *Daucus* and related taxa, which is shared only by *D. glochidiatus* (Constance & Chuang, 1982; Constance, Chuang & Bell, 1976; Iovene et al., 2008).

Banasiak et al. (2016) obtained the most complete phylogenetic trees to date on this expanded *Daucus* (s.l.) clade, with nuclear (nrITS) and three plastid markers. Comparative studies of concordance and discordance in phylogenies built from various molecular markers (e.g., Wendel & Doyle, 1998) have shown that plastid phylogenies are the most discordant relative to other molecular markers, caused by various reasons. Spooner et al. (2017) demonstrated that these nuclear and plastid markers sometimes produce incongruent results. Our present results show additional significant incongruences that we interpret with morphological, chromosome and biogeographic data as discussed below.

CLADE B, *DAUCUS SETULOSUS* AND *DAUCUS ARCANUS*

Within clade B, most major subclades showed weak bootstrap support values in the combined nrDNA and plastid DNA tree of Banasiak *et al.* (2016). In our ML and MP phylogenetic trees, clade B is arranged into three subclades with strong support ($BS \geq 90\%$), but as mentioned above, SVD trees often have different cladistic relationships within these clades, and with lower bootstrap supports. According to Banasiak *et al.* (2016), *D. setulosus* (from Greece) is sister to the '*guttatus-littoralis*' clade (from Israel and Egypt), but that relationship is weakly supported ($BS = 46\%$). Conversely, our ML and MP results show *D. setulosus* as sister to the '*arcanus-pusillus*' clade (from the Americas and the Iberian Peninsula) with a strong support ($BS \geq 90\%$). Although results by Banasiak *et al.* (2016) show low resolution for *D. setulosus*, some similarities are found with our tree, since their nrDNA ITS and combined plastid trees show the '*arcanus-pusillus*' clade sister to a clade including the '*setulosus*' plus the '*guttatus-littoralis*' group ($BS = 49\%$), and *D. setulosus* is again nested with the '*arcanus-pusillus*' clade ($BS = 31\%$) in their nrDNA ITS tree. Our SVD results, in contrast, resolve *D. setulosus* with *D. conchitae* and *D. littoralis*, but with low (52%) bootstrap support.

Separately, all three of our results highlight a close relationship between the Iberian *D. arcanus* and *D. pusillus*, previously noted by Lee & Park (2014) based in nrITS data. After studying the morphology of both taxa, and despite of the often smaller size of *D. arcanus* (Fig. 3), we assume that the Iberian species fits well within the wide morphological plasticity observed for *D. pusillus* throughout South and North America. Thus, both taxa are treated here as conspecific, with *D. pusillus* the priority name. *Daucus arcanus* is only known from a few distant localities in southern Spain and Portugal (García-Martín & Silvestre, 1990; Martín-Blasco & Carrasco, 1997; Martínez-Flores, 2016; Porto & Pereira, 2018; E. Sánchez-Gullón, pers. comm.)

(Fig. 4). The eventual connection between the New World to the Iberian Peninsula remains unclear. The mericarps of *D. pusillus* (incl. *D. arcanus*) are the smallest within the genus *Daucus* (Martínez-Flores, 2016) (Fig. 3B), and the fruits of genus *Daucus* are easily dispersed by wind and animals (Lacey, 1981; Okeke, 2015). Thus, the introduction of *D. arcanus* to the Iberian Peninsula could be the result of a long-distance dispersal similar to recent introductions of *D. glochidiatus* to Europe (Okeke, 2015), such as the wide dispersal of *D. carota* to South Africa and Australia (Burt, 1991; Groves, 2003); a dispersal mechanism common in Apiaceae (Banasiak *et al.*, 2013). The type locality of *D. arcanus* (Matalascañas, Doñana National Park) is about 40 km southwest from the ancient harbour of Palos de Moguer, in Huelva province, and about 30 km northwest from Sanlúcar de Barrameda (the entry to the harbour of Seville throughout the Guadalquivir river), in Seville province (Spain). After 1492, all this area received a large amount of maritime traffic from America, a fact that could explain the introduction of *D. pusillus* to southern Spain and Portugal.

CLADE B, *DAUCUS CONCHITAE* GREUTER AND *D. INVOLUCRATUS* SM.

The relationship between *D. conchitae* and *D. involucratus* is strongly supported in all our analyses (BS \geq 90%) and that of Banasiak *et al.* (2016). Banasiak *et al.* (2016) found that the '*conchitae-involucratus*' clade was closely related to *D. bicolor* (BS = 99%). These three species grow in Turkey. Our ML and MP results resolve the '*conchitae-involucratus*' clade as sister to all other species in clade B, whereas *D. bicolor* is included in a strongly supported (BS \geq 90%) wider clade also including *D. guttatus*, *D. littoralis* Sm., *D. durieua* and *D. glochidiatus*. Species within this wider clade inhabit mainly the eastern Mediterranean region (with *D. durieua* also present in the Iberian Peninsula and *D. glochidiatus* being endemic to Oceania). SVD, in contrast, resolve *D. conchitae* and *D. involucratus* as very weakly supported

(52% bootstrap) sister to *D. setulosus* (these three species growing along the lands surrounding the Aegean Sea).

CLADE B, *DAUCUS DURIEUA* AND THE ALLOPOLYPLOID *D. MONTANUS*

In Banasiak *et al.* (2016) and in all three analyses of our present study, as in other recent phylogenies, the position of *D. durieua* remains unclear. According to Banasiak *et al.* (2016), it is sister to the '*glochidiatus-montanus*' clade in a weakly supported relationship (BS = 64%). Our results (Fig. 1) are similar, but our ML and MP evidence supports an allopolyploid origin of *D. montanus* from *D. glochidiatus* and *D. pusillus*. *Daucus montanus* and *D. glochidiatus* are morphologically similar (i.e., pollen shape and ornamentation, leaf indumentum, bract number, petal shape and size, mericarp length, style length, relative size of glochidia). *Daucus montanus* and *D. pusillus* also share several morphological characteristics such as petal shape and size, style length, anther size and pollen features (Sáenz, 1981; Okeke, 2015; Martínez-Flores, 2016). *Daucus glochidiatus* is found in Oceania and its chromosome number is $2n = 44$, whereas *D. pusillus* inhabits North and South America and its chromosome number is $2n = 22$. Finally, *D. montanus* occurs in Central and South America and its chromosome number is $2n = 66$. The three species therefore share the basic number $x = 11$ (Constance *et al.*, 1976; Iovene *et al.*, 2008; Okeke, 2015). Spalik *et al.* (2010) suggested several *Daucus* dispersal events from the Old World to the New World and, successively, a dispersal from South America to Australia (during the late Pliocene). Our ML and MP results highlight a relationship between the Australian *D. glochidiatus* and the American *D. pusillus*. Nevertheless, there are no records of *D. glochidiatus* today in South America where *D. pusillus* and *D. montanus* grow, so the likely mechanism of the hybrid origin of *D. montanus* involving these species is unclear and would remain entirely

speculative. This hypothesis is better supported by our results than an eventual autopolyploidy from *D. pusillus* as Okeke (2015) suggested.

CLADE A – THE MACARONESIAN TAXA

Clade A groups several *Daucus* species, encompassing the type of the genus, *D. carota*. As well, taxa traditionally included in other genera, such as *Cryptotaenia*, *Melanoselinum*, *Monizia*, *Pseudorlaya* and *Tornabenea* also occur in clade A. According to the phylogenetic tree of Banasiak et al. (2016), the ‘*Melanoselinum-Monizia*’ clade is sister to the remaining species in clade A. The rest of that clade forms a group with a weak support (BS = 67%), including *Cryptotaenia elegans* in a basal position. These relationships remain unresolved in their plastid DNA trees.

Relative to Banasiak et al. (2016), our ML and MP results show a strongly supported ‘*crinitus-setifolius-tenuisectus*’ clade sister to the ‘*Melanoselinum-Monizia*’ clade and the remaining groups of clade A (*Cryptotaenia* was not analysed). The SVD results are quite different with *D. tenuisectus* as sister to all remaining species in clade A, and quite different interspecific relationships among the remaining species, but the Macaronesian species maintained in its own well-supported clades. These Macaronesian taxa show characters very different from the classic concept of genus *Daucus*. All three produce mericarps without spines. *Cryptotaenia elegans* is distinguished by a reduced or absent involucre and mericarps lacking secondary ridges and trichomes on the primary ridges (Martínez-Flores, 2016). Its chromosome number $2n = 16$ (Suda, Kyncl & Jarolímová, 2005) is only shared by both species in *Pseudorlaya*. *Melanoselinum decipiens* and *Monizia edulis* differ from the rest of species in several characteristics as long-life span, small tree-sized habit, very long (7.6–16.8 mm) dorsally compressed mericarps with dorsal secondary ridges clearly smaller than the lateral ones and hypertrophied commissural vitae (Martínez-Flores, 2016).

CLADE A, *DAUCUS MURICATUS* L. AND *D. TENUISECTUS* COSS. EX BATT.

In Banasiak *et al.* (2016), a '*muricatus-tenuisectus*' clade (BS = 70% in their study) is sister to the remaining *Daucus* species in clade A, except for the 'Macaronesian group' being successive sister groups of the whole aggregate). Conversely, our ML and MP results place *D. tenuisectus* in a strongly supported clade (92% BS) containing *D. crinitus* and *D. setifolius* (*sensu lato*) whereas *D. muricatus* and *D. aureus* are sister in a separate moderately supported clade (Fig. 1). And our SVD analysis resolves *D. tenuisectus* as sister to the other species in clade A (Fig. 2).

Daucus aureus and *D. muricatus* have many morphological features suggesting they are sister, such as the extreme reduction of vitae, the ray indumentum, the reflexed bracts (Martínez-Flores, Juan & Crespo, 2012), the pollen ornamentation and the primary commissural ridges crowded together (Martínez-Flores, 2016). The position of *D. tenuisectus*, though strongly supported in our ML and MP analysis, is ambiguous in previous studies. The nrITS phylogenetic tree in Banasiak *et al.* (2016) placed *D. tenuisectus* together with *D. muricatus* in a weakly supported clade (BS = 60%). However, their plastid DNA data indicated that *D. tenuisectus* could be closer to *Rouya polygama* Coincy, *D. syrticus* and *D. carota*, although resolution is weak (BS = 54%). The most evident morphological features seem insufficient to clarify *D. tenuisectus* affinities, and further detailed studies are therefore needed.

CLADE A -*DAUCUS CRINITUS* AND *DAUCUS SETIFOLIUS*

Both Banasiak *et al.* (2016) and our phylogenetic analysis demonstrate that *D. crinitus* and *D. setifolius* are strongly supported sister taxa (BS ≥ 90%). These species show distinctive morphological characters from other *Daucus*. They are the only species to be polycarpic hemicryptophytes, producing leaves

with filiform to very narrow segments apparently verticillate (pseudoverticillate), and producing mericarps elongate (up to 7.2–8.0 mm long; mean ratio length/width \pm 4.3–4.9), with soft spines, glochidia reduced to a short straight apex and styles very long (up to 3.5–3.9 mm) (Martínez-Flores, 2016). Both species are found in the western Mediterranean (Tunisia, Algeria, Morocco, Spain and Portugal, Fig. 5), and they share the diploid chromosome number $2n = 22$ (Aparicio & Silvestre, 1985; Silvestre, 1993 [as "*D. brachylobus* Boiss."]). We here distinguish two distinct species formerly referred to as *D. setifolius* (Fig. 6). Both have very similar mericarps but they can be easily differentiated by the indumentum of stems and leaf sheaths, the branching pattern and their allopatric distribution. The typical *D. setifolius* shows an indumentum of minute retrorse trichomes on the basal third of stem and leaf sheaths; it produces numerous long primary and secondary branches in a common Apiaceae branching pattern with long pedunculate umbels (Fig. 6A,B), and grows in northern Morocco, Algeria and Tunisia, along the Atlas mountains, with only a single Spanish population in the western Penibetic mountains (Málaga province) (Fig. 5, squares). On the contrary, *D. junceus* exhibits an indumentum of antrorse trichomes on the basal third of stem and leaf sheaths (an exclusive character not found in any other representative of clade A), and it has very short pedunculated to sessile umbels, with very few or no primary branches, forming a distinctive branching pattern within *Daucus* (Fig. 6C,D), resembling a *Juncus* L. species. That rush-like morphology led Willkomm (1851) to describe it as *Durieuva juncea*. According to our research, *D. junceus* is endemic to southwestern Iberian Peninsula along the river basins and surrounding mountains (Fig. 5, circles and asterisks). Our phylogenetic results are congruent with the recognition of two morphologically distinct species. The Banasiak *et al.* (2016) plastid DNA tree also analysed *D. junceus* (Spanish *D. setifolius* 237 collected in Seville province) and is likewise separated from

D. setifolius (Algerian 467 and Spanish G56 collected in Málaga province).

Both species are not clearly separated in their combined analysis, possibly due to plastid/ITS incongruence, or different plastid/ITS analysed taxa.

CLADE A, *DAUCUS* MAIN GROUP PLUS CLADE A'

Regarding the remaining groups within clade A, our phylogenetic analysis coincides with results in Banasiak *et al.* (2016). The 'Pseudorlaya clade' (*D. minusculus* and *D. pumilus*) is highly supported (BS \geq 90%), and sister to the remaining clades. Both of these species have a distinctive morphological syndrome: annual habit, zygomorphic umbels (both involucre and rays arrangement), short styles (0.4–0.9 mm), mericarps with two rows of spines per ridge and sparse indumentum in primary commissural ridges (0–5 trichomes/mm) (Martínez-Flores, 2016), and both share the same chromosome number $2n = 16$ (García-Martín & Silvestre, 1985; Vogt & Oberprieler, 1994; Mohamed, 1997). *Daucus rouyi* is placed between the 'Pseudorlaya clade' and the 'Daucus main group' plus clade A'. *Daucus rouyi* formerly was the sole member of a monotypic genus, *Rouya*, found in a reduced area in northern Corsica, Sardinia, northeastern Algeria and northern Tunisia. It is well characterised by its polycarpic chamaephytic habit, the small erect petals (\pm 1.3 mm), the widely winged mericarps (1.9–3.1 mm width), lack of spines on secondary ridges and lack of trichomes on primary ridges, (Martínez-Flores, 2016), and a chromosome number $2n = 20$ (Constance *et al.*, 1976). The remaining *Daucus* species (clade A') share a chromosome number $2n = 18$ (Reese, 1957; Grosso *et al.*, 2008; Iovene *et al.*, 2008), patent petals usually longer than 1.3 mm, mostly spiny and not clearly winged secondary ridges, primary ridges with indumentum, and according to our molecular phylogenetic studies are nested in a strongly supported clade (BS \geq 90%). *Daucus gracilis* (unknown chromosome number) is sister to these species while *D. syrticus* Murb. is sister to the 'carota-Tornabenea' (*D. annuus* and *D. tenuissimus*) clade. The

former genus *Tornabenea* includes several species endemic of Cape Verde, which are characterised mainly by fruits with very narrowly 'winged' secondary ridges. However, Martínez-Flores (2016) found that morphological characters in the former genus *Tornabenea* such as the mericarp size, vitae shape, style length, or pollen size and ornamentation, are very similar to those in *D. carota*, and even extremely reduced spines can be observed on the mericarp narrow 'wings', like in some taxa in the complex of *D. carota* (Pujadas-Salvà, 2003). Different chromosome numbers were reported within these species. Brochman *et al.* (1997) and Grosso *et al.* (2008) indicated $2n = 18$ for *Daucus annuus* and *D. insularis* (= *T. insularis* (Parl.) Parl.), and Bramwell & Murray (1972) $2n = 18$ for *T. hirta* J.A.Schmidt (no *Daucus* name to date). However, Borgen (1980) reported $2n = 16$ for *T. hirta* and Borgen (1974) indicated the same latter number for *D. tenuissimus*, while Bramwell & Murray (1972) found $2n = 22$ in *T. bischoffii* J.A.Schmidt (no *Daucus* name to date). According to our results, $2n = 18$ is congruent with the former members of *Tornabenea* closely related to *Daucus carota*, and based on those facts, some of those species may be included in the genus *Daucus*, as formally transferred by Banasiak *et al.* (2016). In summary, notable discrepancies exist on the taxonomy of these former members of *Tornabenea*, both in morphology (Grosso *et al.*, 2008) and in chromosome numbers (Bramwell & Murray, 1972; Borgen, 1974, 1980; Brochman *et al.*, 1997; Grosso *et al.*, 2008). No molecular and morphological revision of these species is available and they are in need of further detailed analyses.

NOMENCLATURAL PROPOSALS

***Daucus setifolius* Desf., Fl. Atlant. 1: 244, t. 65. 1798**

Staflinus setifolius (Desf.) Raf., New Fl. 4: 28. 1838 \equiv *Pomelia setifolia*
(Desf.) Durando ex Pomel, Mat. Fl. Atl.: 7. 1860 \equiv *Meopsis setifolia*
(Desf.) Koso-Pol. in Trudy Tiflissk. Bot. Sada 16: 196. 1914.
Daucus brachylobus Boiss., Voy. Bot. Espagne 2: 258, t. 68. 1840.

Lectotype (designated here): [ALGERIA]. Prope Mascar in collibus incultis,
Desfontaines (P-00320312!). Isolectotypes: G-00023270 (digital image!),
MPU-021024 (digital image!). Note: Previous indication of "holotype" in the
electronic publication of Okeke's (2015) PhD thesis should be regarded as
"lectotype", but such typification is not effective according to Art. 29.1
of the ICN (Turland *et al.*, 2018) since that publication lacks ISBN, ISSN
or doi number. The lectotype designated here is a specimen from
Desfontaines's "Herbier de la Flore Atlantique" among the historical
collections at P.

Ind. loc.: 'Habitat prope Mascar in collibus incultis' [Algeria]

Brief description: Polycarpic hemicryptophyte; stems minutely pubescent at
the basal third, with retrorse trichomes; primary and secondary stem branches
numerous and elongated, with long pedunculated umbels; leaves with basal
sheath covered with retrorse trichomes, and with filiform to very narrow
segments apparently verticillate (pseudoverticillate); mericarps elongate
cylindric-ovoid, mostly covered with a dense indumentum, secondary ridges
with soft spines and glochidia reduced to a short straight apex, styles very
long, vittae subtriangular in section.

Chromosome number: $2n = 22$ ($n = 11$; Silvestre, 1993 [as *D. brachylobus*
Boiss.]).

Ecology: Degraded brushwood areas, often in rocky places. Usually on ultrabasic substrates (i.e., peridotites, serpentines) and sometimes on acid ones (i.e., basalts, sandstones).

Distribution: Morocco, northern Algeria and northern Tunisia along the Atlas Mountains, with only a relict Spanish population in the western Penibetic Mountains (Málaga province).

Selected specimens: see Appendix.

***Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo, comb. nov.**

Durieuva juncea Willk. in Flora 34: 711. 1851 [basion.]

Lectotype (designated here): [SPAIN]. "76. d. (coll. sel.) / *Durieuva hispanica* ? Boiss. Reut. [cross outs literal transcription of the label] / *juncea*, Willk! / in graminosis inter frutices / in solo granitico declivium vallis / fluvii Jerte pr. Plasencia in / Estremadura, 10/1850 / legit Willk.) (BM-000752080 [digital image!]). Isolectotype: P-02461299 [digital image!]).

Ind. loc.: 'Hab. in graminosis inter saxa granitica in valle fluvii Jerte prope Plasencia in Extremadura hinc inde' [Spain]. Pl. ex. coll. ven. select. n. 76 d.

Diagnosis: Very akin to *D. setifolius* from which it differs mainly by the stems covered at the basal third with antrorse trichomes, identical to those coating the leaf sheaths (an exclusive character not found in any other representative of clade A); and by the primary branches absent or very scarce, bearing subsessile to very shortly pedunculated umbels (often several small umbels grouped together).

Chromosome number: $2n = 22$ ($n = 11$; Aparicio & Silvestre, 1985 [as "*D. setifolius*"]).

Ecology: Roadsides, borders of fields and degraded brushwood areas, often near rivers. Usually on acid substrates (i.e., granites, schists, etc.).

Distribution: Endemic to southwestern Iberian Peninsula along the river basins (Guadalquivir, Guadiana, Tajo) and surrounding mountains. Only one population had been reported to the north of that indicated area (Almeida *et al.*, 2009). Unfortunately, that population was destroyed due to the construction of a dam (C. Aguiar, pers. comm.).

Selected specimens: see Appendix.

***Daucus pusillus* Michx., Fl. Bor.-Amer. 1: 164. 1803**

Babiron pusillum (Michx.) Raf., New Fl. 4: 23. 1836.

Daucus brevifolius Raf., New Fl. 4: 26. 1836.

Daucus hispidifolius Clos, Fl. Chil. 3(2): 135. 1848.

Daucus microphyllus Presl ex DC., Prodr. 4: 213. 1830 \equiv *Daucus pusillus*

var. *microphyllus* (C.Presl ex DC.) Torr. & A.Gray, Fl. N. Amer. 1(4): 636. 1840.

Daucus montevidensis Link ex Spreng., Syst. Veg., ed. 16, 4(2, Cur. Post.):

119. 1827.

Daucus pusillus var. *scaber* Torr. & Gray, Fl. N. Amer. 1(1): 636. 1840. \equiv

Daucus scaber Nutt. ex Torr. & A.Gray, Fl. N. Amer. 1(4): 636. 1840.

Daucus scaber Larrañaga, Escritos Damaso Antonio Larrañaga 2: 113. 1923,

nom. illeg.

Daucus scadiophylus Raf., New Fl. 4: 24. 1838.

Daucus arcanus García-Martín & Silvestre in Lagasalia 15: 263. 1990, **syn.**

nov.

Lectotype (designated here): [USA]. "*Daucus pusillus* / in sabulosis / Carolinae" (P-00320342!). Note: Previous indication of "holotype" in the electronic publication of Okeke's (2015) PhD thesis should be regarded as "lectotype", but such typification is not effective according to Art. 29.1 of the ICN (Turland *et al.*, 2018) since that publication lacks ISBN, ISSN or doi number. Furthermore, the Canadian voucher selected by that author, "In America bor. occid. ad Nootka-Soud", Haenke (G-DC)", is not acceptable since it cannot be regarded as original material of *D. pusillus* (Michaux, 1803). The lectotype designated here is a specimen from "*Herbier de l'Amérique septentrionale d'André Michaux*" at P, collected in Carolina and matching with the protologue of that name.

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FIGURE LEGENDS

Figure 1. Strict consensus maximum parsimony tree of 48, 8341-length trees constructed with 10 nuclear orthologous gene sequences of allele set B, without *Daucus montanus*, but with this species drawn in manually based on individual allele results supporting it as an allopolyploid species between *D. pusillus* and *D. glochidiatus*. Chromosome numbers supporting these clades (Table 2) are shown in blue bracketed type and bootstrap support values in black non-bracketed type.

Figure 2. Singular-value decomposition (SVD) quartets analysis using the multispecies coalescent option with 100 bootstrap replicates constructed with 10 nuclear orthologous gene sequences of allele set B, without *Daucus montanus*. With *D. montanus* this species is supported as an allopolyploid between *D. pusillus* and an unidentified species. Chromosome numbers supporting these clades (Table 2) are shown in blue bracketed type and bootstrap support values in black non-bracketed type.

Figure 3. Specimen of *Daucus pusillus* Michx. (including *D. arcanus* García Martín & Silvestre) collected in Ciudad Real, Spain (ABH78367): A, habit; B, detail of fruiting umbels.

Figure 4. Distribution of *Daucus pusillus* Michx. (including *D. arcanus* García Martín & Silvestre) in the Iberian Peninsula. See Appendix for a detailed list of records.

Figure 5. Distribution of *Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo (circles) and *D. setifolius* Desf. (squares), based on studied herbarium specimens and reliable photographic records. Asterisks indicate trustworthy

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3 bibliographic references and databases for *D. junceus*. See Appendix for a
4 detailed list of records.
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8 **Figure 6.** Specimens of *Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo and
9 *D. setifolius* Desf. *Daucus setifolius* A: herbarium specimen ABH78370
10 collected in Málaga, Spain; B: natural population of *D. setifolius* from
11 Málaga, Spain, accession E-107; *D. junceus* C: herbarium specimen ABH53906
12 collected in Seville, Spain; D: natural population of *D. junceus* from Jaén,
13 Spain, accession Ames 33893.
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SUPPLEMENTARY FILES

Supplementary file 1. Genebank deposition numbers.

Supplementary file 2. Number of alleles in each of the 10 nuclear orthologous gene sequences examined here.

Supplementary file 3. Maximum parsimony tree statistics for the four main analyses (A and B set allele trees, with and without *Daucus montanus*) conducted here.

Supplementary file 4. The eight A and B set allele trees (equally parsimonious and majority rule strict consensus) constructed with 10 nuclear orthologous gene sequences.

Supplementary file 5. The individual nuclear ortholog bootstrap consensus trees of the A allele set (10 trees) and B allele set (10 trees; 20 trees in total).

Supplementary file 6. The maximum likelihood tree constructed with 10 nuclear orthologous gene sequences of allele set B, without *Daucus montanus*. Bootstrap support values are given above the branches.

Supplementary file 7. The allele set A and B SVD trees with and without *D. montanus* and allele set B with *D. montanus*.

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Table 1. The 40 additional accessions of *Daucus* examined in this study, voucher, and locality information^a.

Species and genebank number	Voucher	Genebank or new collections in 2016 (Spain)	Accession ^b	Location
Outgroup				
<i>Athamanta sacula</i> 1301	PTIS (photo)	France	France 1301	Morocco.
Traditional Daucus ingroups				
<i>Daucus arcanus</i> 33768 E-29	ABH 78367	Spain	F. Martínez- Flores E- 029	Spain, Ciudad Real, ca 25 km NW of Piedrabuena, top of hill with antenna, mountain Navalagrulla, in fenced private area of Finca de Nuestra Señora del Rosario, S of CR-721, ca 500 m NNE of towers on dirt logging road
<i>Daucus aureus</i> 33769	PTIS	Spain	Ames 33769	Spain. Sevilla: leaving Sanlúcar la Mayor, ca 10 km W of Sevilla, just W of town on S side of road, Rt A472
<i>Daucus aureus</i> 33770	PTIS	Spain	Ames 33770	Spain. Córdoba: junction of gravel road and road from Santa Cruz and Espejo (N432), near salt evaporation ponds, 5 m SE of Santa Cruz
<i>Daucus aureus</i> 33771	PTIS	Spain	Ames 33771	Spain. Córdoba: N of Baena on Rt 325 near junction of CO 284, adjacent to Guadajoz River.
<i>Daucus aureus</i> 33772	PTIS	Spain	Ames 33772	Spain. Jaén: near Laguna Honda, side of Vía Verde del Aceite
<i>Daucus aureus</i> 33773	PTIS	Spain	Ames 33773	Spain. Jaén: on Rt. JV-3054, ca. 600 m W of junction with Rt. A-316 at Estación de Begíjar
<i>Daucus guttatus</i> 1303		France	France 1303	France. Sillans la Cascade
<i>Daucus crinitus</i> 33833	PTIS (photo)	Spain	Ames 33833	Spain. Sevilla: leaving Sanlúcar la Mayor, ca 10 km W of Sevilla, just W of town on S side of road, Rt A472.
<i>Daucus crinitus</i> 33834	PTIS	Spain	Ames 33834	Spain. Córdoba: along road from Baena to Alcaudete (Rt. N-432), at junction of Rt. A-333, by bridge
<i>Daucus crinitus</i>	PTIS (photo)	Spain	Ames 33838	Spain. Ciudad Real: ca 10 km SW of Manzanares on CR- 5212, at the spring of Siles

33835					
<i>Daucus</i>	PTIS	Spain	Ames 33836	Spain. Ciudad Real: along the roadside and up steep	
<i>crinitus</i>	(photo)			slope by road	
33836					
<i>Daucus</i>	PTIS	Spain	Ames 33838	Spain. Badajoz: below Cornalvo dam, ca 15 km NE of	
<i>crinitus</i>				Mérida	
33838					
<i>Daucus</i>	PTIS	Spain	Ames 33839	Spain. Ciudad Real: on dirt road 100 m N and also 1	
<i>durieua</i>				km N of CM-413, ca. 3.5 km W of Aldea del Rey	
33839					
<i>Daucus</i>	PTIS	Spain	Ames 33840	Spain. Ciudad Real: 3.5 km NE of Villamayor de	
<i>durieua</i>				Calatrava, then 1 km NW of road on the way to Volcán	
33840				del Morrón de Villamayor	
<i>Daucus</i>	PTIS	Spain	Ames 33841	Spain. Ciudad Real: ca 2.3 km NW of outskirts of	
<i>durieua</i>				Piedrabuena, on Camino de la Reguerilla	
33841					
<i>Daucus</i>	PTIS	Spain	Ames 33842	Spain. Ciudad Real: ca 25 km NW of Piedrabuena, La	
<i>durieua</i>				Charca de las Colmenas, S of CR-721	
33842					
<i>Daucus</i>	PTIS	Spain	Ames 33845	Spain. Toledo: Rt. CM-5001, N of Talavera de la	
<i>durieua</i>				Reina, ca. 1 km N of N end of San Román de los	
33845				Montes	
<i>Daucus</i>	PTIS	Spain	Ames 33846	Spain. Toledo: hills above El Real de San Vicente, on	
<i>durieua</i>				Rt. TO-9045V	
33846					
<i>Daucus</i>		England	HRIGRU 8251	Australia.	
<i>glochidiatus</i>					
s					
HRIGRU8251					
<i>Daucus</i>		England	HRIGRU 6677	Morocco. Region Goumina: 18 km NE of Goumina on road	
<i>gracilis</i>				to Ksar es Souk	
HRIGRU6677					
<i>Daucus</i>	PTIS	France	France 816f	Chile. Juan Fernandez Islands, Camote	
<i>montanus</i>					
816					
<i>Daucus</i>	PTIS	Spain	Ames 33850	Spain. Málaga: road from Álora to Carratraca (A7007),	
<i>muricatus</i>				ca. 5 km W of N end of Álora, ca. 1 km W of km 4	
33850				road sign	
<i>Daucus</i>	PTIS	Spain	Ames 33851	Spain. Málaga: ca. 1 km up hill on unnamed farm road	
<i>muricatus</i>				ascending mount El Hacho, off of road from Álora to	

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3	33851				Carratraca (A7007), beginning just E of Restaurant	
4					Los Conejitos	
5	<i>Daucus</i>	Field	Spain	Ames 33852	Spain. Cádiz: ca 1 km N of San Roque in fenced field	
6	<i>muricatus</i>	photo E5			just after going through gate, between Fuente Maria	
7	33852				España and Arroyo (stream) de la Mujer	
8	<i>Daucus</i>	PTIS	Spain	Ames 33853	Spain. Badajoz: below Cornalvo dam, ca 15 km NE of	
9	<i>muricatus</i>				Mérida	
10	33853					
11	<i>Daucus</i>	ABH78370	Spain	F.	Spain. Málaga: along road from Estepona to Jubrique,	
12	<i>setifolius</i>			Martínez-	between km 6-7 (at water collection station by road	
13	33891 E-107			Flores E-		
14				107		
15	<i>Daucus</i>	ABH78369	Spain	Ames 33890	Spain. Huelva: Rd. N-435 ca. 8 km N of La Nava.	
16	<i>junceus</i>					
17	33890, E-					
18	101					
19	<i>Daucus</i>	ABH56276	Spain	Ames 33893	Spain. Jaén: Rumbiar river, next to Rd. JV-3151, near	
20	<i>junceus</i>				bridge (Puente del Rumbiar), ca. 700 m S. of Zocueca	
21	33893 E-122					
22	<i>Daucus</i> ingroups					
23	recently					
24	transferred to					
25	<i>Daucus</i>					
26	<i>Daucus</i>	PTIS	France	France 1306	Portugal. Quinta do Jardim da Serra, Madère	
27	<i>decipiens</i> =	(photo)				
28	<i>Melanoselin</i>					
29	<i>um</i>					
30	<i>decipiens</i>					
31	1306					
32	<i>Daucus edulis</i>	PTIS	France	France 1307	Portugal. Madère	
33	= <i>Monizia</i>	(photo)				
34	<i>edulis</i> 1307					
35	<i>Daucus</i>	PTIS	Spain	Ames 33854	Spain. Cádiz: Punta Paloma	
36	<i>minusculus</i>					
37	=					
38	<i>Pseudorlaya</i>					
39	<i>miniscula</i>					
40	33854					
41	<i>Daucus</i>	Field	Spain	Ames 33855	Spain. Cádiz: Cabo Roche, sand dunes about lighthouse	
42	<i>minusculus</i>	photo				
43	33855	E9, PTIS				

<i>Daucus</i>	PTIS	Spain	Ames 33856	Spain. Málaga: Beach Cabopino ca 10 km W of
<i>pumilus</i> =				Fuengirola
<i>Pseudorlaya</i>				
<i>pumila</i>				
33856				
<i>Daucus</i>	PTIS	Spain	Ames 33858	Spain. Cádiz: Beach Tarifa, ca 500 M N of harbor
<i>pumilus</i>				
33858				
<i>Daucus</i>	Field	Spain	Ames 33859	Spain. Cádiz: Punta Paloma
<i>pumilus</i>	photo			
33859	E8, PTIS			
<i>Daucus</i>	Field	Spain	Ames 33861	Huelva. at the SE end of Matalascañas, on sand dunes
<i>pumilus</i>	photo			
33861	E13,			
	PTIS			
<i>Daucus</i>	PTIS	France	France 817	France. Corcica, Corse Bonifacio
<i>pumilus</i> 817				
<i>Daucus annuus</i>	PTIS	France	France 819	Cape Verde. Sao Tiago Malagueta
=				
<i>Tornabenea</i>				
<i>annua</i> 819				
<i>Daucus</i>	PTIS	France	France 818	Cape Verde. Fogo Chãdas Caldeiras
<i>tenuissimus</i>				
=				
<i>Tornabenea</i>				
<i>tenuissima</i>				
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^aDNA sequences and locality data of the 85 accessions not listed here were obtained from Arbizu *et al.* (2014, 2016).

^bAmes numbers are assigned for carrots and other Apiaceae in the US National Plant Germplasm System temporarily to newly acquired germplasm until passport data of an accession and taxonomy is verified. In addition, accessions with Ames numbers have to be determined they are not duplicate accession, and that they can be successfully maintained. These accessions may or may not be assigned a PI number after the assessment period.

Table 2. Chromosome numbers of the species examined here. We found no references for chromosome numbers for *Daucus bicolor*, *D. conchitae* and *D. gracilis*.

Taxon	2n	References and available data for the specimens
<i>Athamanta sicula</i>	22	Colombo & Marcenó (1989), Italy; Shner, Alexeeva & Pimenov (2018), Italy.
<i>Daucus arcanus</i>	22	García-Martín & Silvestre (1990), Spain.
<i>Daucus aureus</i>	22	Constance et al. (1976), -; Silvestre (1986), Spain, (Seville, SEVF Cuesta de las Doblas).
<i>Daucus capillifolius</i>	18	Iovene et al. (2008), Libya (NPGS PI 279764).
<i>Daucus carota</i> s.l.	18	Gadella & Kliphuis (1966), Holland; Queirós (1974), Portugal; cf. Okeke (1978), - ; Lago & Castroviejo (1993), Spain, (Santander); Iovene et al. (2008), several localities.
<i>Daucus crinitus</i>	22	Aparicio & Silvestre (1985), Spain (SEV 47250); Iovene et al. (2008), Portugal (NPGS PI 652413).
<i>Daucus decipiens</i> = <i>Melanoselinum decipiens</i>	22	Bell & Constance (1966), - .
<i>Daucus durieua</i>	20	Kapoor & Löve (1969), Spain (Palas del Rey); Queirós (1974), Portugal (Bragança).
	22	Owens (1974), ut <i>D. subsessilis</i> , Israel (Negev, Hinket Coll.); Silvestre (1986), Spain, (Barcelona, SEVF Tibidabo; Cádiz, SEVF 39806); Luque & Díaz-Lifante (1991), Spain (Granada, Jerez del Marquesado).
<i>Daucus edulis</i> = <i>Monizia edulis</i>	22	Dalgaard (1991), - .
<i>Daucus glochidiatus</i>	44	Constance et al. (1976), Australia; Iovene et al. (2008), Australia.
<i>Daucus guttatus</i>	20	Vogt & Aparicio (1999), Cyprus (Ayia Anna, UPA n° Rec.It.: 0152); Iovene et al. (2008), ut <i>D. broteri</i> , Siria (NPGS PI 652342).
<i>Daucus involucratus</i>	22	Vogt & Aparicio (1999), Cyprus (Ayia Anna, MA495558).
<i>Daucus junceus</i>	22	Aparicio & Silvestre (1985), ut <i>D. setifolius</i> Spain, Seville (SEV 42820);
<i>Daucus littoralis</i>	20	Iovene et al. (2008), Israel (NPGS PI 341902).
<i>Daucus minusculus</i> = <i>Pseudorlaya minuscula</i>	16	Vogt & Oberprieler, (1994), - .
<i>Daucus montanus</i>	66	Constance et al. (1976), several localities; Iovene et al. (2008), ut <i>D. hispidifolius</i> Clos., Chile (HRI 7189).
<i>Daucus muricatus</i>	22	Queirós (1974), Portugal (several localities); Vogt & Oberprieler, (1994), - .
<i>Daucus pumilus</i> = <i>Pseudorlaya pumila</i>	16	García-Martín & Silvestre (1985), Spain (SEVF Chipiona); Ruiz de Clavijo (1994), Spain (Huelva COFC Isla Saltés); Mohamed (1997), Egypt.
<i>Daucus pusillus</i>	22	Constance et al. (1976), several localities; Iovene et al. (2008), Argentina and USA.
<i>Daucus rouyi</i> = <i>Rouya polygama</i>	20	Constance et al. (1976), - .
<i>Daucus setifolius</i>	22	Silvestre (1993), ut <i>D. brachylobus</i> Boiss., Spain (SEVF Jubrique- Estepona).
<i>Daucus setulosus</i>	20	Iovene et al. (2008), ut <i>D. guttatus</i> , Greece (NPGS PI 652326).
<i>Daucus syrticus</i>	18	Reese (1957), - .
<i>Daucus tenuisectus</i>	22	Constance et al. (1976), Morocco?
<i>Daucus</i> (<i>Tornabenea</i> sp. pl.)	16	<i>T. tenuissima</i> : Borgen (1974), Cape Verde (Sao Nicolau); <i>T. hirta</i> : Borgen (1980), Cape Verde (Sao Nicolau).
	18	<i>T. hirta</i> : Bramwell & Murray (1972), Cape Verde (Santiago); <i>T. annua</i> and <i>T. insularis</i> : Brochman et al. (1997), Cape Verde; Ídem: Grosso et al. (2008), Cape Verde.

	22	<i>T. bischoffii</i> : Bramwell & Murray (1972), Cape Verde (Santo Antao).
<i>Orlaya daucooides</i>	16	Silvestre (1978), <i>ut</i> <i>O. kochii</i> Heywood, Spain (SEV27540, SEV27542, SEV27543); Engstrand (1979), Turkey.

PDF Proof

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Table 3. Summary of the cladistic placement of both alleles of *Daucus montanus* in the A and B random allele sets examined here.

Marker and allele set	With all 3 <i>D.</i> <i>pusillus</i>	With both <i>D.</i> <i>glochidiatus</i>	With at least one <i>D.</i> <i>glochidiatus</i>	Insufficient structure to determine	Not amplify in <i>D. montanus</i>
3374 A set			X		
3374 B set		X			
3902 A set	X				
3902 B set	X				
10366 A set			X		
10366 B set		X			
10966 A set				X	
10966 B set				X	
15347 A set					X
15347 B set					X
16308 A set	X				
16308 B set		X			
16577 A set	X				
16577 B set		X			
16645 A set	X				
16645 B set		X			
32914 A set	X				
32914 B set	X				
35097 A set				X	
35097 B set	X				

APPENDIX

Localities of selected specimens of *Daucus pusillus* (Fig. 4) and of *D. junceus* and *D. setifolius* (Fig. 5).

***Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo**

PORTUGAL. Beja: Moura, matorral exposición N, junto a ribera del Ardila, 14.x.1994, *M. Lousã et al.* (LISI596); Moura, ribera de Ardila, 107 m, 12.x.2009, *J. Calvo & S. Hantson* #JC4246 (MA794634); Estimated coordinates: 37°27'14.1"N 8°42'53.5"W, 37°42'33.5"N 7°42'57.2"W, 37°50'11.9"N 8°28'48.2"W, 37°58'14.7"N 7°18'53.1"W, 38°04'40.4"N 7°07'25.5"W, 38°09'12.4"N 6°59'46.6"W, 38°11'17.1"N 8°11'39.8"W and 38°11'48.0"N 7°13'12.1"W, *M. Porto, F. Clamote, A.J. Pereira, U. Schwarzer. Daucus setifolius* Desf. - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wDaucus+setifolius> [accessed 22/08/2018]; **Bragança:** Macedo de Cavaleiros, Lagoa, leito de cheias do rio Sabor, junto à foz do Rio Azibo, 225 m, 15.vi.2003, *C. Aguiar & J. Capelo* s/n (Herb. Esc. Sup. Agr. Bragança 5982), Extinct (*C. Aguiar*, pers. comm.); **Castelo Branco:** Idanha-a-velha, 11.ix.2015, *F. Clamote* (obotanicoaprendiznateradosespantos.blogspot.com!); Sertã, Mosteiro de Sao Tiago, na serra, *J. Domingues de Almeida, Bot. Complut.* 30: 147-151 (2006) (www.anthos.es #2062096); **Évora:** Estimated coordinates: 38°25'57.8"N 8°14'02.0"W, *M. Porto, F. Clamote, A.J. Pereira, U. Schwarzer. Daucus setifolius* Desf. - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wDaucus+setifolius> [accessed 22/08/2018]; **Lisboa:** Cabeço de Mil Regos, viii.1885, *J. Daveau* #721 (P02461302!, P04328984!); Serra da Arrábida, 1879, *J. Daveau* (P02461301!); Serra de Montejunto, 30.ix.2015, *F. Clamote*

(obotanicoaprendiznaterradosespantos.blogspot.com!); **Portalegre:** Freixo do Meio, em solos compactos ricos em bases e biótopos medianamente nitrófilos, influenciados pelo homem e animais, 144-146 m, *M. Pereira, Guineana* 15: 5-316 (2009) (www.anthos.es #2297084); Ribeira das Alcáçovas, nas fissuras terrosas de rochas graníticas e quartzíticas, 80-150 m, *M. Pereira, Guineana* 15: 5-316 (2009) (www.anthos.es #2295657); **Santarém:** Ribatejo, Entroncamento, illegible (MA168162); Estimated coordinates: 39°10'39.1"N 8°49'06.9"W, *M. Porto, F. Clamote, A.J. Pereira, U. Schwarzer. Daucus setifolius* Desf. - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wDaucus+setifolius> [accessed 22/08/2018]; **Setúbal:** Estimated coordinates: 38°07'20.7"N 8°21'54.8"W, 38°27'49.3"N 9°03'59.2"W and 38°40'04.8"N 8°36'11.6"W, *M. Porto, F. Clamote, A.J. Pereira, U. Schwarzer. Daucus setifolius* Desf. - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wDaucus+setifolius> [accessed 22/08/2018]; Cercal, *M. Ladero, Anales del Instituto Botánico Cavanilles* **31(1)**: 119-137 (1974) (www.anthos.es #1180884); **SPAIN. Albacete:** Alcaraz, vii.1848, *F. Michael* (COI00058771!); **Ávila:** Cebreros, Laderas arenosas junto al Puente del Carpintero, en la carretera al Burguillo, 12.ix.1992, *V.J. Arán & M.J. Tohá* (FCO25111); Cebreros, Rd. AV-504, ca. 1 km SW of town of Cebreros, environs of Puente del Carpintero and Arroyo de los Galayos, 2.ix.2016, *F. Martínez-Flores et al.*, #E-095 (ABH78368); **Badajoz:** Arroyo de Friegamuñoz entre Cheles y Villanueva del Fresno, no regolfo da albufeira de Alqueva, 13.x.1994, *M. Lousã et al.* (LISI570); Mérida, Trujillanos, proximidades del Embalse de Cornalvo, 310 m, 11.ix.2008, *A. Sánchez* (ABH53888); Zurbarán, 3 km al E., tomillar en raña pliocena, 15.ix.1979, *J.L. Pérez-Chicano* (MA309860); La Serena, *M. Ladero, Anales del Instituto Botánico Cavanilles* **31(1)**: 119-137 (1974) (www.anthos.es #1171790); Puebla de Alcocer, *M. Ladero, Anales del Instituto Botánico Cavanilles* **31(1)**: 119-137 (1974) (www.anthos.es #1171791);

Cáceres: Guadalupe, taludes umbrosos de Guadalupe, 5.ix.1969, *S. Rivas-Goday et al.* (FCO02676); Plasencia, Extremadura, ad rupes graniticas in valle fluvii Jerte prope Plasencia, x.1850, *H.M. Willkomm* #76d (BM000752080!, COI00058767!); Plasencia, carretera de la Vera, 27.viii.1986, *E. Rico* (MA561136); Zorita, litosol sobre pizarras precámbricas 1 km al norte de Zorita, 14.ix.1997, *J.L. Pérez Chiscano* (MA594719); Charco de la Torre, pastizales vivaces xerofíticos y termófilos, *M.D. Belmonte-López*, Ph. D. Thesis, Universidad Complutense de Madrid (1986) (www.anthos.es #1715410); Valle de Tornavacas, in collibus reg. calidae super. raro, *Graells, H.M. Willkomm & J.M.Ch. Lange. Prodromus florae Hispanicae*, vol. **3** (1874-1880) (www.anthos.es #2372238); Villareal de San Carlos, *M.D. Belmonte-López*, Ph. D. Thesis, Universidad Complutense de Madrid (1986) (www.anthos.es #1715420);

Ciudad Real: Solanilla del Tamaral, Rd. CR-5002, between km 6-7, by bridge (Puente Mercedes) over Río Jándula, SE side of the bridge, 6.ix.2016, *F. Martínez-Flores et al.*, #E-117 (ABH78371); Almuradiel-Venta de Cárdenas, *C.J. Martín-Blanco & M.A. Carrasco. Monografías de la AHIM* **1** (2005) (www.anthos.es #1842395); Calzada de Calatrava, cerro Calderón, 680 m., 15.ix.1991, *Fernández García-Rojo* (JAEN 914579) (www.anthos.es #1842393); Ciudad Real, La Atalaya, 670 m., *L. Pablos-Alcázar, Plantas silvestres de Ciudad Real-La Atalaya* (2004) (www.anthos.es #1869258); Comarca de Estena, 5.ix.1965, *S. Rivas-Goday et al.* (MAF 71752) (www.anthos.es #1842386); Herencia, Montes de Toledo, de Herencia a Villarta de San Juan, 800 m, 22.ix.1981, *C.J. Martín-Blanco & M.A. Carrasco. Monografías de la AHIM* **1** (2005) (www.anthos.es #1842385); Horcajo de los Montes, taludes de borde de caminos, 5.ix.1965, *Ladero* (MAF80390) (www.anthos.es #1842392); Mestanza, valle del río Jándula, 420 m, 14.ix.1996, *García-Río* (www.anthos.es #1842388); Moral de Calatrava, sierra de Moral de Calatrava, 25.v.1989, *Carrasco et al.* (MACB 37164) (www.anthos.es #1842387); **Córdoba:** Bélmez, 1869, *Ch. Rouques* (P02461300!); Castillo de la Albaida, 7.x.2007, *J. Trinado* (pers. comm.); Santa María de

Trasierra en dirección al arroyo Bejarano, 20.ix.2009, *J.F. Moreno* (pers. comm.); subida a Cerro Muriano, 13.x.1978, *Pérez-Chiscano* (SEV55551!); Montilla, Fuente Rodas, 17.x.2001, *Garrido & Pérez-Porras*, *Acta Botanica Malacitana* **27**: 295-308 (2002) (www.anthos.es #1654412); Sierra Morena, SW, desde Valle del Guadalquivir hasta N de Hornachuelos, embalses de La Breña y de Bembézar, Sierra de Córdoba, *A. Pujadas-Salvá*, *Flora arvense y ruderal de la Provincia de Córdoba*. Edit. Universidad de Córdoba (1986) (www.anthos.es #2310953); **Huelva**: La Nava, Rd. N-435 ca. 8 km N of La Nava, *F. Martínez-Flores et al.*, #E-101 (ABH78369); idem, between km 124-125, near Barranco del Retamar and Casa del Retamar, *F. Martínez-Flores & A. Quílez-Méndez*, #E-123 (v.v.); La Nava a Encinasola, entre cerca Gavana y Puerto de las Adelfas, 315 m, 17.x.2017, *J. Fuentes*; carretera de La Nava a Encinasola, río Múrtigas, cerca Gavana, 326 m, 10.x.2016, *J. Fuentes* (GDA); **Jaén**: Andújar, hacia la Virgen de la Cabeza, en posíos de las viñas de Andújar, 11.ix.1951, *S. Rivas et al.* (FCO02675); Andújar, carretera JV-501, prox. Casa del Naranjal, 460 m, 11.ix.2015, *M. Cueto & G. Blanca* (GDA); Andújar, sierra Morena, entre casa Navandillos y cerro de Pedro López, 500 m, taludes y herbazales silicícolas, 5.v.2017, *J. Fuentes, G. Blanca & M. Cueto* (GDA); Bailén, paraje Piedras de Doña Inés, margen del río Rumblar, 240 m, 23.xi.2009, *P. Rodríguez-Cobo* (ABH55115); Baños de la Encina, Barranco del Oso, orilla sureste del río, 16.x.2009, *P. Rodríguez-Cobo* (pers. comm.); Sierra Morena in dumetis apricis inter pagos Santisteban del Puerto et Aldeaquemada atque alibi frequens, 28.viii.1945, *H.M. Willkomm* (COI00058770!); Villanueva de la Reina, Zocueca, Puente del Rumblar, 240 m, 19.viii.2010, *F. Martínez-Flores* (ABH56276); idem, 6.ix.2016, *F. Martínez-Flores et al.*, #E-122 (v.v.); Viñas de Andújar, c. Santamaría de la Cabeza, 11.ix.1951, *S. Rivas-Goday & E.F. Galiano* (MA166100); Río Navalajeta, 11.vi.1986, *E. Cano-Carmona & F. Valle-Tendero*, *Monografías del Jardín Botánico de Córdoba* **4**: 5-73 (1996) (www.anthos.es #1332792); Santa Elena, comarca, 700 m, *S. Rivas-Goday et al.*, *Anales del*

Instituto Botánico Cavanilles **17(2)**: 285-403 (1959) (www.anthos.es #1764863);
Vílches, Arroyo Galapagar, 440 m, A. Payer-Martos, *Blancoana* **14**: 85-92 (1997)
(www.anthos.es #1031813); **Salamanca**: Santibáñez de la Sierra, F.J. Fernández-
Díez. V *Trabajos del Departamento de Botánica Salamanca* **4**: 5-32 (1977)
(www.anthos.es #60392); **Seville**: Alcalá de Guadaira, Hacienda de los Ángeles,
50 m, 10.ix.2008, A. Aparicio (ABH53906); Carmona, Cuatro Caminos,
24.ix.1977, S. Silvestre #8498 (MA359174, P04199154!, P04328983!, SEV42820!);
Lora del Río, al N, 250 m, S. Rivas-Goday et al., *Anales del Instituto*
Botánico Cavanilles **17(2)**: 285-403 (1959) (www.anthos.es #1764866); Sevilla,
Gerena, Corredor de la Plata, río Guadiamar, 80 m, A.V. Pérez la Torre et
al., *Acta Botanica Malacitana* **27**: 189-228 (2002) (www.anthos.es #1653856);
Paradas, 50 m, S. Rivas-Goday et al., *Anales del Instituto Botánico*
Cavanilles **17(2)**: 285-403 (1959) (www.anthos.es #1764865); **Toledo**: Alcaudete
de la Jara, pizarroso silíceo seco, 1.ix.1982, A. Segura-Zubizarreta
(MA359231); Cazalegas, 30.ix.2012, R. Angulo (www.biodiversidadvirtual.org
#197328); Hinojosa de San Vicente, encinar arenoso-granítico, 5.x.1979, A.
Segura-Zubizarreta (MA359180); Los Yébenes, Montes de Toledo, Puerto del
Comendador, 26.vii.1992, V.J. Arán & M.J. Tohá (FCO25110); Los Yébenes,
19.ix.1986, Gómez-Manzaneque (MAF349663); Oropesa, taludes sobre pizarras
cámbricas, 2.ix.1976, M. Ladero (FCO08194); Velada, arenoso-silíceo,
16.viii.1980, A. Segura-Zubizarreta (MA359143); Velada-Gamonal, arenoso-
granítico, 13.xi.1977, A. Segura-Zubizarreta (MA359209); Castell. San Pablo
de Montes, H.M. Willkomm & J.M.Ch. Lange, *Prodromus Florae Hispanicae*, 3,
Stuttgart. (1874-1880) (www.anthos.es #1564085); San Román de los Montes,
arroyo de Guadamora, 430 m, P. Cantó, *Lazaroa* **25**: 187-249 (2004)
(www.anthos.es #1675177).

***Daucus pusillus* Michx. (incl. *D. arcanus* García-Martín & Silvestre)**

PORTUGAL. Évora: 38°54'01.8"N 7°40'38.3"W, *M. Porto & A.J. Pereira. Daucus arcanus* García Martín & Silvestre - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wDaucus+arcanus> [accessed 22/08/2018]; **SPAIN. Huelva:** Almonte, Matalascañas, sabinars, 24.iv.1986, *F. García-Martín & Silvestre* (SEV126880!; SEV126881); ídem, 11.iv.1989, *Aparicio et al.* (K000681200!, MA490772!, SEV126880); Almonte, dunas del Asperillo, 15.v.1995, *E. Sánchez-Gullón & P. García-Murillo* (COA32418!); Matalascañas, carretera A-494 de Matalascañas a Mazagón, 30 m, 27.iv.2009, *F. García-Martín & J. Pastor* (ABH53887); grown in Seville, 10.iii.1990, from mericarps collected by *Aparicio et al.*, vii.1875 (MA490773, SEV227030); Las Marismillas, Parque Nacional de Doñana, 2016, *E. Sánchez-Gullón* (pers. comm.); **Ciudad Real:** Piedrabuena, Cerro Navalagrulla, canchal cuarcítico, 885 m, 17.vi.1993, *Burgaz et al.* (MACB56965!); ca 25 km NW of Piedrabuena, top of hill with antenna, mountain Navalagrulla, in fenced private area of Finca de Nuestra Señora del Rosario, S of CR-721, 15.vi.2016, *F. Martínez-Flores & D.M. Spooner* #E-029 (ABH78367).

***Daucus setifolius* Desf.**

ALGERIA: Ain Defla: Zaccar-monte Zaccar, 1100 m, v.1919, *Ch. Alleizette* (P02517373!); **Annaba:** Djebel Edough près Bone, 20.viii.1860, *A.H. Letourneux* (COI00058768!, P02517382!, P02517390!, P02517397!, P02517398!, P02517399!, P02517400!, P02517401!, P02517403!, P02517404!); **Argel:** Reghaïa, rares seches en lisiere de la foret, 3.x.1937, *L. Faurel* (P04328042!); **Blida:** Blidah, 13.vii.1854, *E. Cosson* (P02517374!); Sidi Madani, Chiffa, 30.vi.1930, *L. Faurel* (P04328040!); **Constantine:** coteaux près du lac du Djebel-el-Ouach, 7.ix.1857, *S. Choulette* #236 (P02517375!, P02517376!, P02517379!, P02517388!, P04101340!); Djebel el Ouach pres Constantine, 26.v.1880, *E. Cosson* (P02517377!); **Oran:** Oran, *F. Garrigues* (MO1606527!); Oran province, 1874, *A.*

Warious (MO1789631!); Oran, in montibus, x.1850, *Munby* (P02517396!); Oran
 Hamarnah, près Sidi bel Abbis, ix.1863, *Lefrane* (P02517385!, P02517386!
 P02517389!); Maquis près Sidi bel Abbis, 28.ix.1874, *A. Warious* (P02517420!,
 P02517421!, P02517425!); **Setif**: Djebel Magris, lieux arides, sur le calcaire,
 1600 m, 1898, *Juillet* #234 (P02517412!); Massif des Babors, 1500 m,
 19.vii.1937, *L. Faurel* (P04328041!); **Sidi Bel Abbès**: Tenira, clairiers du
 forêts, ix.1871, *A. Warious* (P02517423!, P02517424!); **Skikda**: Stora, ix.1839,
Bové (P02517367!, P02517369!, P02517370!); **Tiaret**: Tiaret, 1845, *Delastre*
 (P02517392!, P02517393!, P02517394!); **Tissemsilt**: Teniet el Haad, forêt de
 cedrus, 23.vii.1854, *E. Cosson* (P02517380!); **Tipasa**: Marengo (Hadjout),
 17.ix.1861, *J. Lefebvre* (P02517387!); Tipaza, au sud de Desaix, 18.x.1963, *L.*
Faurel (P04328038!); **Tlemcen**: Terny, en Aïn-Ghoraba, 1300 m, 11.viii.1932, *A.*
Faure (MA89070, MA89071, MO1098506!); **MOROCCO: Fès-Boulemane**: Anocour,
 x.1913, *Mouret* n°1579 (P02517427); **Drâa-Tafilale**: Road from El-Ksiba to
 Imilchil, c. 9 km N from Tizi-n-Isly, 1440 m, 5.vii.1997, *S.L. Jury et al.*
 #17514 (RNG!); **Souss-Massa-Drâa**: Aït Mahalla, 25.vii.1879, *Ibrahim*
 (P02517433!, P02517434!); **Tadla-Azilal**: Djebel Bouachfal, 3.viii.1882,
Ibrahim (P02517429!, P02517431!); **Taza-Al Hoceima-Taounate**: Bab Azhar, 1500
 m, 4.viii.1938, *L. Faurel* (P04328043!); **TUNISIA: Ben Arous**: Bou-Kournein pr.
 Hammam-El-Lif, 9.v.1883, *E. Cosson et al.* (P02517438!); **Jendouba**: Fedj El Sa-
 ha (Kroumirie), north of Ferrara, 30.vi.1883, *E. Cosson et al.* (P02517435!,
 P02517436!, P02517437!). **SPAIN. Málaga**: Inter pagum Alozaina et oppidulum
 Yunquera, 1845, *P. Prolongo y García*, (COI00058769!); Coín, Sierra Alpujata,
 500 m, taludes peridotíticos, 20.x.2016, *J. Fuentes, G. Blanca & M. Cueto*
 (GDA); Estepona to Jubrique, km 6-7, 4.ix.2016, *F. Martínez-Flores et al.*,
 #E-107 (ABH78370); Estepona, Sierra Bermeja, bco. del Infierno, peridotitas,
 300 m, 20.x.2016, *J. Fuentes, G. Blanca & M. Cueto* (GDA); Estepona, Sierra
 Bermeja, bco. del Infierno, 300 m, matorrales orientados al O., sustrato
 peridotítico, 11.x.2017, *J. Fuentes* (GDA); entre Alozaina y Jorox, casas del

Arroyo de las Viñas, 510 m, taludes peridotíticos orientación O., 7.iv.2017, *J. Fuentes, G. Blanca & M. Cueto* (GDA); Istán, entre Cuesta del Alcornocal y río Verde, 250 m, matorral termófilo orientación O., peridotítico, 11.x.2017, *J. Fuentes* (GDA); San Pedro de Alcántara, río Guadaiza, Benavolá Alto, 200 m, taludes peridotíticos orientación E., bajo pinar entre matorral, 11.x.2017, *J. Fuentes* (GDA); San Pedro de Alcántara, río Guadaiza, El Colorao, 150 m, matorral termófilo en peridotitas, orientación O., 11.x.2017, *J. Fuentes* (GDA); Antequera, Sierra del Torcal, *B. Cabezudo et al.*, *Acta Bot. Malacitana* **17**: 145-166 (1992) (www.anthos.es #1046749); Circà Alhaurin, in collibus regionis calidae superioris, E. Boissier, Voyage botanique dans le midi de L'Espagne pendant l'anne 1837, vol. 2. Paris, Gide et Cie., Libraires-éditeurs (1839) (www.anthos.es #1863783); Istán, Boornoque, *B. Cabezudo et al.*, *Acta Botanica Malacitana* **17**: 145-166 (1992) (www.anthos.es #1046746); Sierra Almijara, *B. Cabezudo et al.*, *Acta Botanica Malacitana* **17**: 145-166 (1992) (www.anthos.es #1046745); Sierra Tejeda, *B. Cabezudo et al.*, *Acta Botanica Malacitana* **17**: 145-166 (1992) (www.anthos.es #1046748).

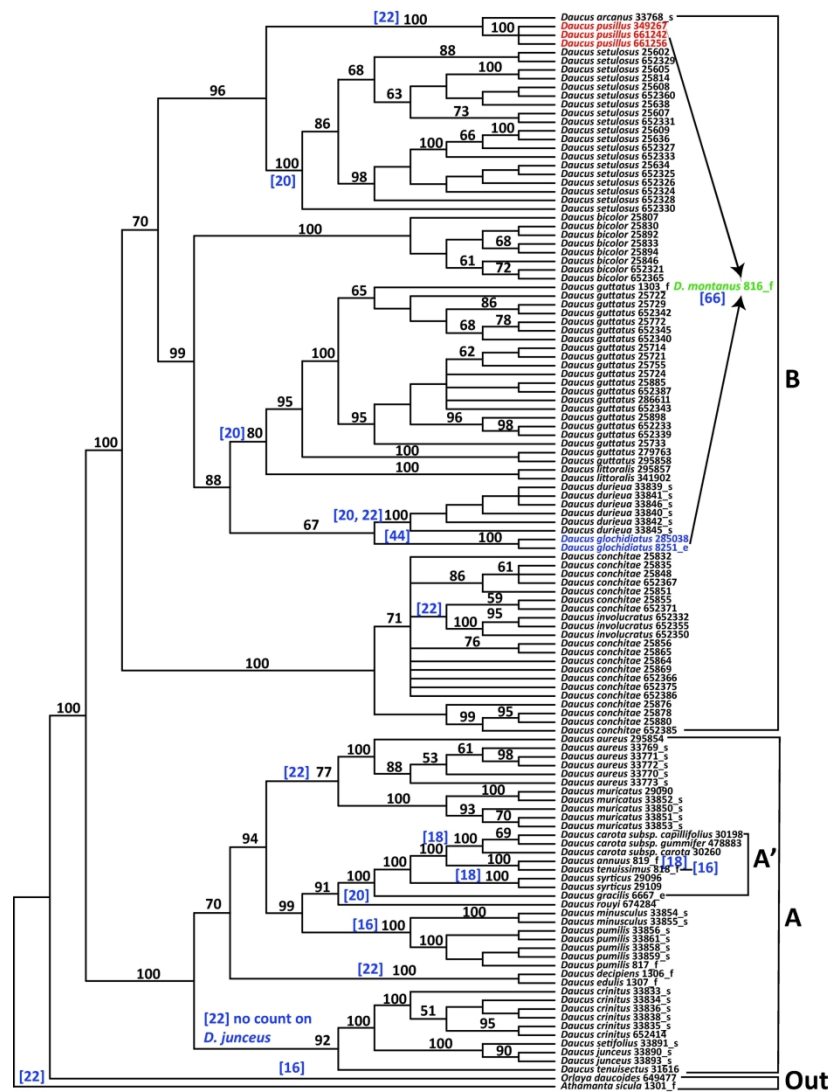


Figure 1. Strict consensus maximum parsimony tree of 48,834-length trees constructed with 10 nuclear orthologous gene sequences of allele set B, without *Daucus montanus*, but with this species drawn in manually based on individual allele results supporting it as an allopolyploid species between *D. pusillus* and *D. glochidiatus*. Chromosome numbers supporting these clades (Table 2) are shown in blue bracketed type and bootstrap support values in black non-bracketed type.

223x256mm (300 x 300 DPI)

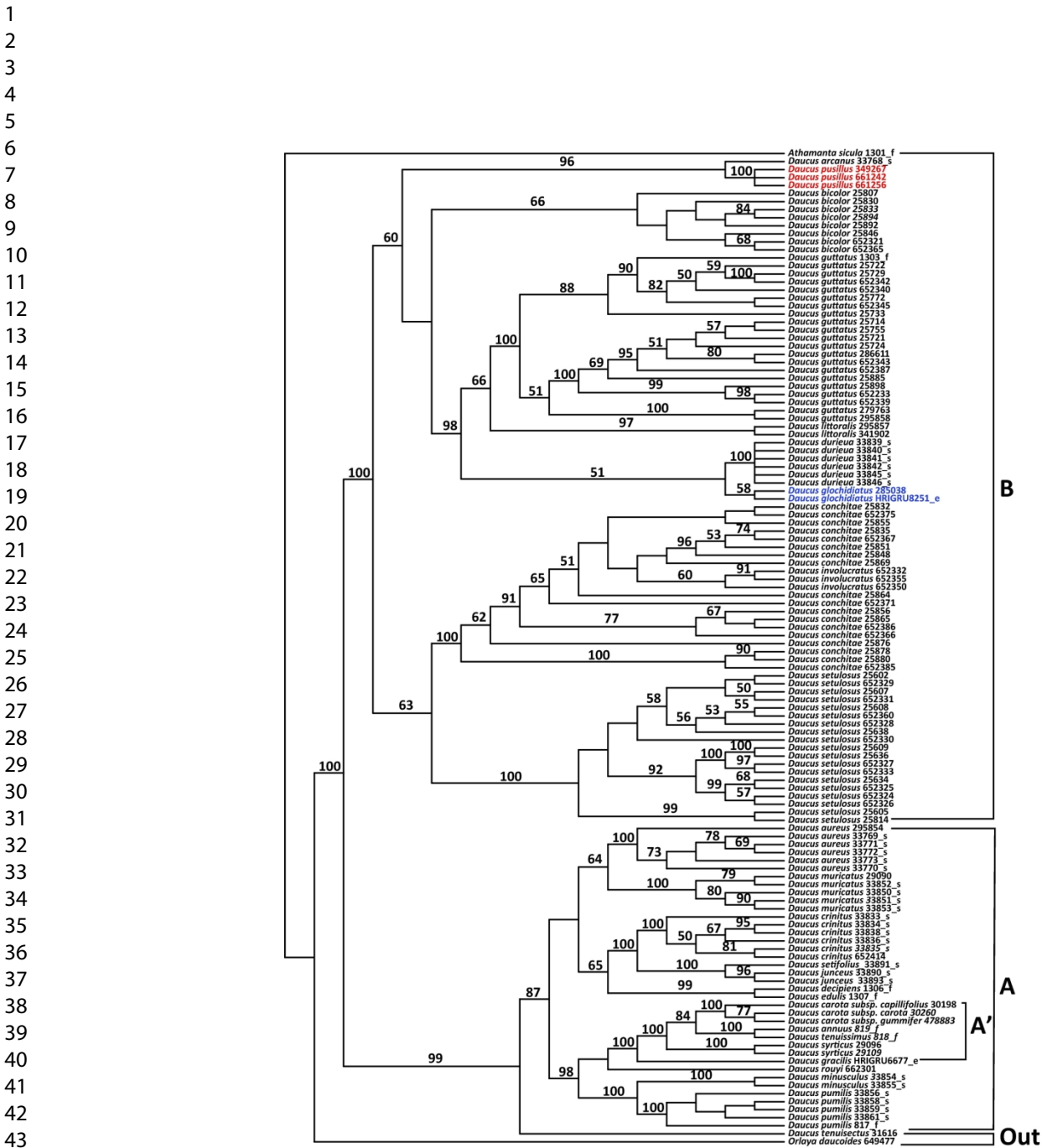


Figure 2. Singular-value decomposition (SVD) quartets analysis using the multispecies coalescent option with 100 bootstrap replicates constructed with 10 nuclear orthologous gene sequences of allele set B, without *Daucus montanus*. With *D. montanus* this species is supported as an allopolyploid between *D. pusillus* and an unidentified species. Chromosome numbers supporting these clades (Table 2) are shown in blue bracketed type and bootstrap support values in black non-bracketed type.

187x243mm (300 x 300 DPI)

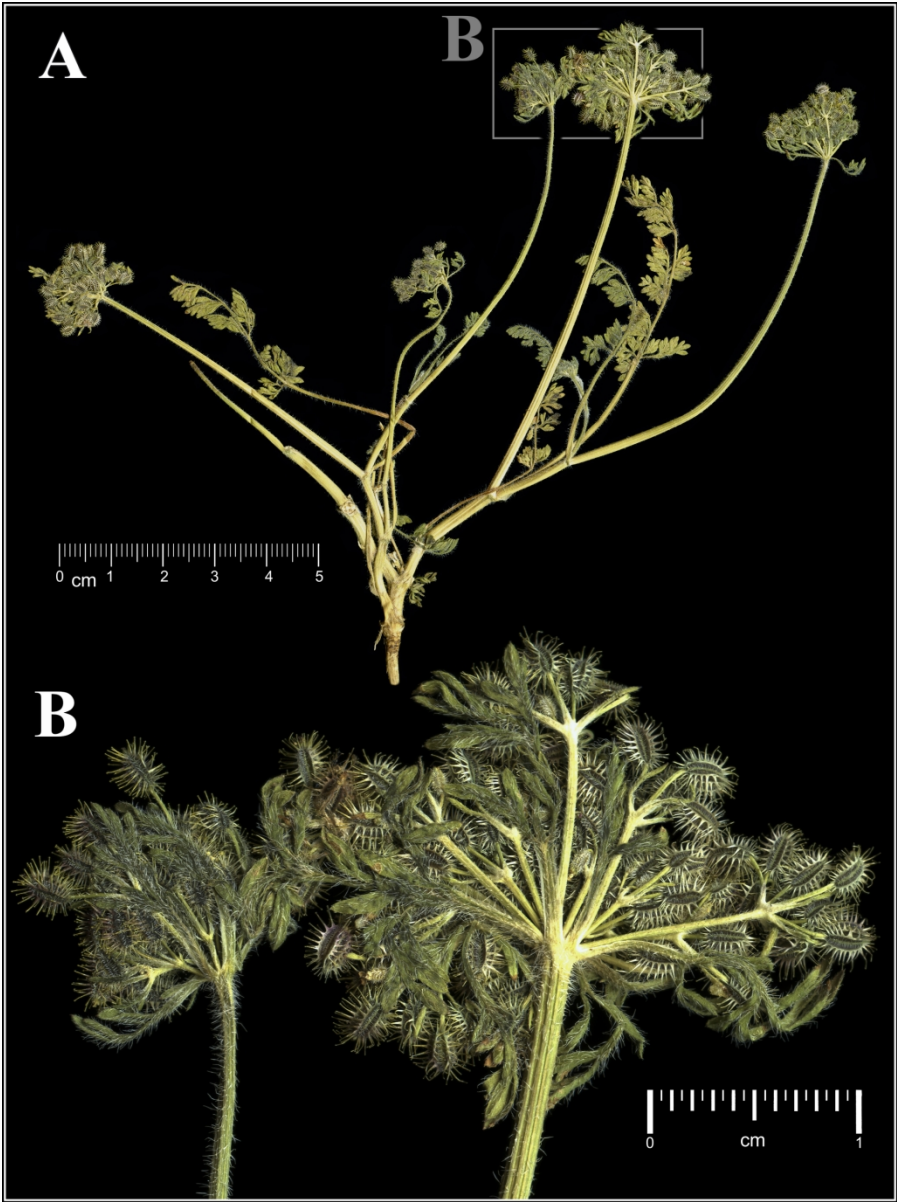


Figure 3. Specimen of *Daucus pusillus* Michx. (including *D. arcanus* García Martín & Silvestre) collected in Ciudad Real, Spain (ABH78367): A, habit; B, detail of fruiting umbels.

167x224mm (300 x 300 DPI)

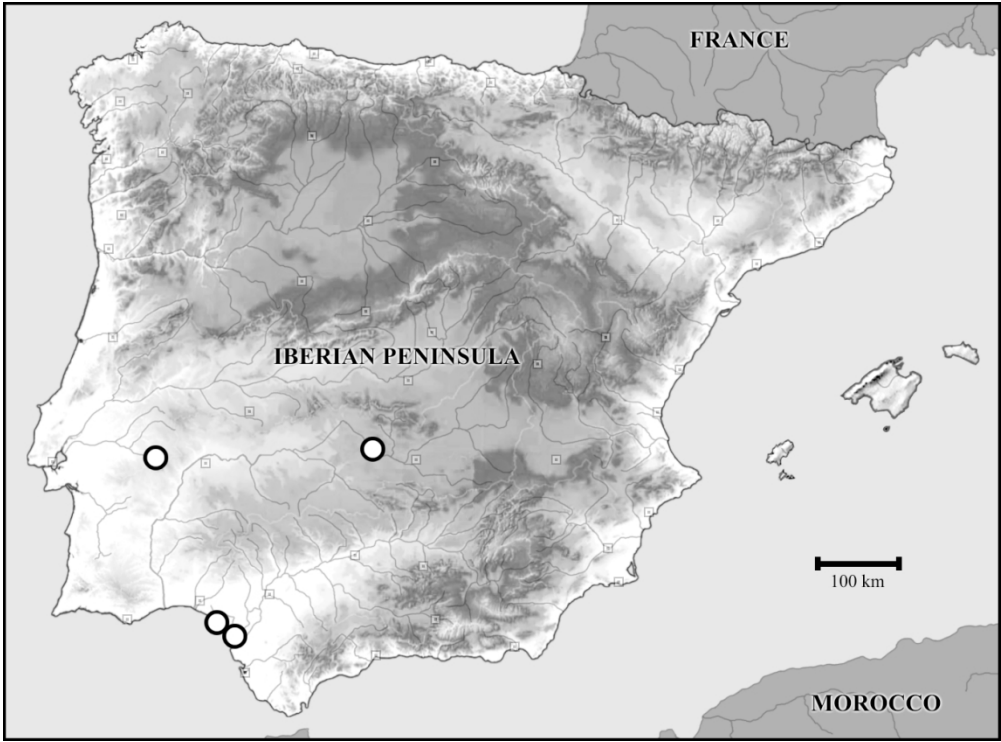


Figure 4. Distribution of *Daucus pusillus* Michx. (including *D. arcanus* García Martín & Silvestre) in the Iberian Peninsula. See Appendix for a detailed list of records.

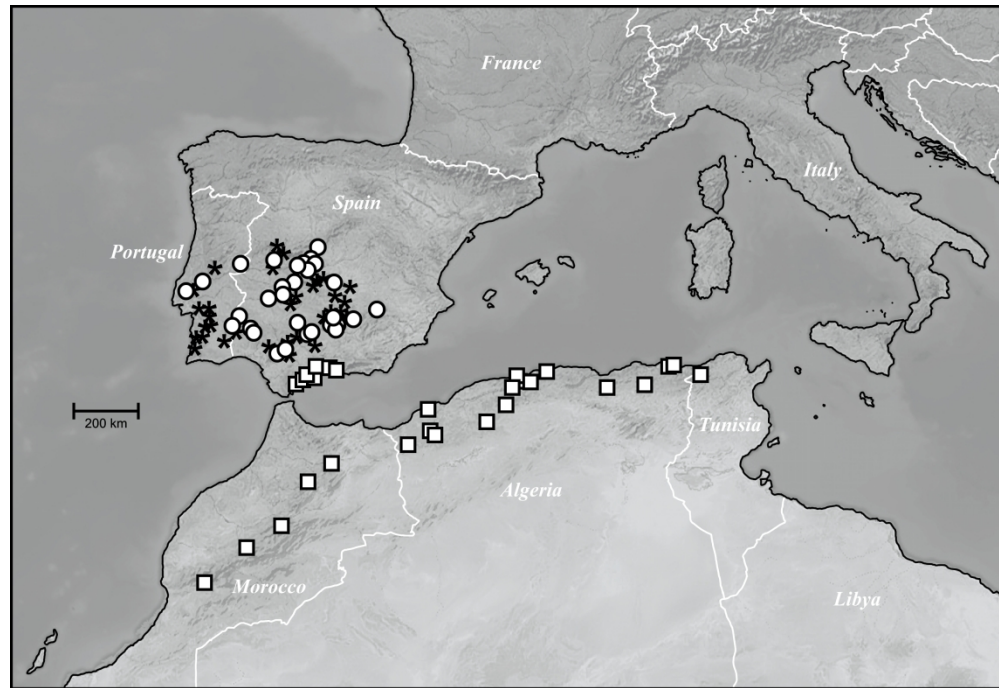


Figure 5. Distribution of *Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo (circles) and *D. setifolius* Desf. (squares), based on studied herbarium specimens and reliable photographic records. Asterisks indicate trustworthy bibliographic references and databases for *D. junceus*. See Appendix for a detailed list of records.

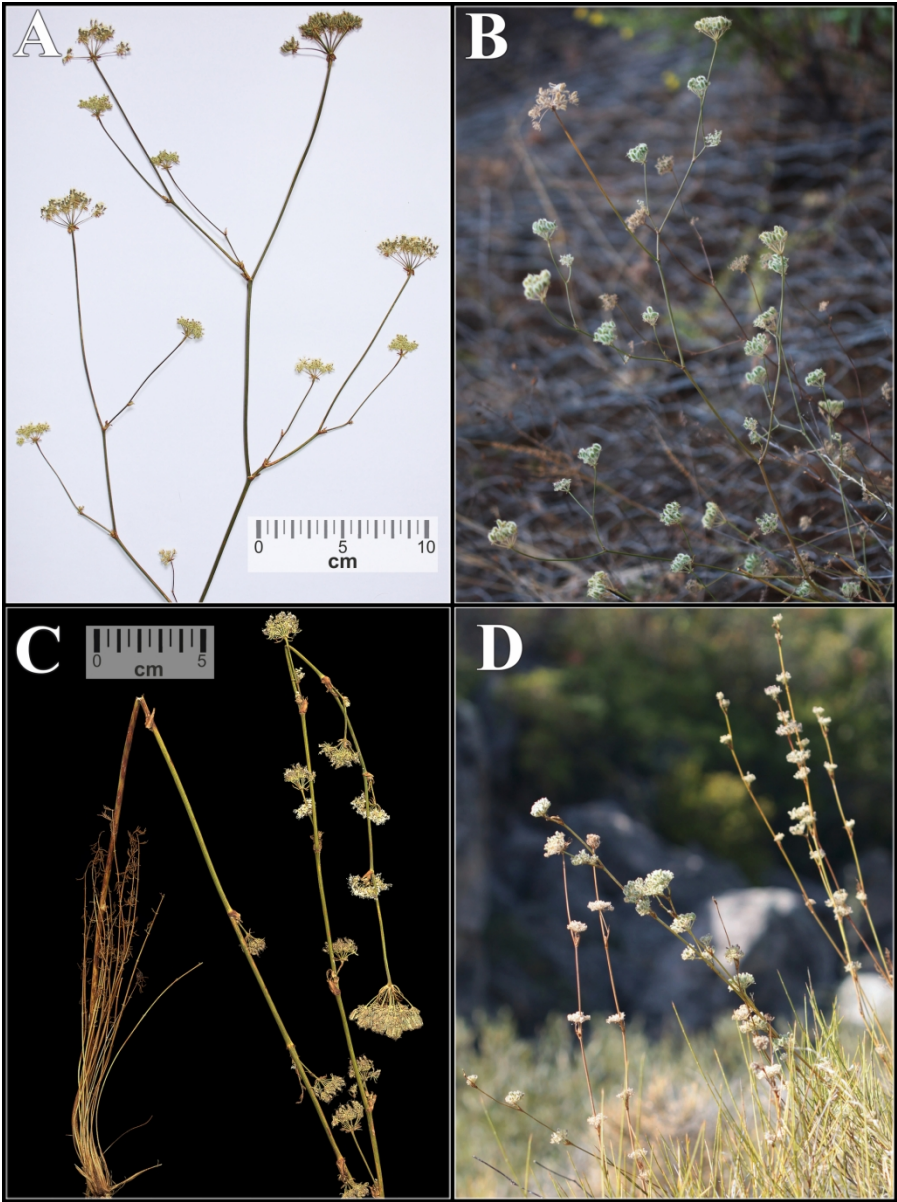


Figure 6. Specimens of *Daucus junceus* (Willk.) Mart.Flores & M.B.Crespo and *D. setifolius* Desf. *Daucus setifolius* A: herbarium specimen ABH78370 collected in Málaga, Spain; B: natural population of *D. setifolius* from Málaga, Spain, accession E-107; *D. junceus* C: herbarium specimen ABH53906 collected in Seville, Spain; D: natural population of *D. junceus* from Jaén, Spain, accession Ames 33893.

167x224mm (300 x 300 DPI)

Supplementary file 1. GenBank deposition numbers of the 10 conserved nuclear orthologs examined here.

	dc10366	dc10966	dc15347	dc16308	dc16577	dc3374	dc3902	dc35097	dc16645	dc32914
Athamanta sicula 1301 f	MK254466	N/A	MK254143	MK254344	MK254303	MK254385	MK254506	MK254221	MK254262	MK254426
Daucus arcanus s	MK254467	MK254182	MK254144	MK254345	MK254304	MK254386	MK254507	MK254222	MK254263	MK254427
Daucus aureus 295854	KJ521468	KJ520952	KJ522041	KJ522338	KJ521368	KJ522145	KJ521941	KJ521571	KJ521059	KJ521166
Daucus aureus 33769 s	MK254468	MK254183	MK254144	MK254346	MK254305	MK254387	MK254508	MK254223	MK254264	MK254428
Daucus aureus 33770 s	MK254469	MK254184	MK254146	MK254347	MK254306	MK254388	MK254509	MK254224	MK254265	MK254429
Daucus aureus 33771 s	MK254470	MK254185	MK254147	MK254348	MK254307	MK254389	MK254510	MK254225	MK254266	MK254430
Daucus aureus 33772 s	MK254471	MK254186	MK254148	MK254349	MK254308	MK254390	MK254511	MK254226	MK254267	MK254431
Daucus aureus 33773 s	MK254472	MK254187	MK254149	MK254350	MK254309	MK254391	MK254512	MK254227	MK254268	MK254432
Daucus bicolor 25807	KU646114	KU646167	KU646215	N/A	KU646316	KU646034	N/A	N/A	KU646368	KU646421
Daucus bicolor 25830	KU646115	KU646168	KU646216	KU646264	KU646317	KU646035	N/A	N/A	KU646369	KU646422
Daucus bicolor 25833	KU646093	KU646143	KU646193	KU646241	KU646292	KU646010	N/A	N/A	KU646344	KU646397
Daucus bicolor 25846	KU646095	KU646145	KU646195	KU646243	KU646294	KU646012	N/A	N/A	KU646346	KU646399
Daucus bicolor 25892	KU646129	KU646182	KU646227	KU646278	KU646330	KU646048	KU646080	N/A	KU646383	KU646436
Daucus bicolor 25894	KU646130	KU646183	KU646228	KU646279	KU646331	N/A	KU646081	N/A	KU646384	KU646437
Daucus bicolor 652321	KU646100	KU646150	KU646200	N/A	KU646299	KU646017	KU646058	KU646452	KU646351	KU646404
Daucus bicolor 652365	KU646106	KU646158	KU646208	KU646255	KU646307	KU646025	KU646066	KU646460	KU646359	KU646412
D. carota ssp. capillifolius 30198	KJ521476	KJ520960	KJ522049	KJ522346	KJ521376	KJ522153	KJ521948	KJ521579	KJ521067	KJ521174
D. carota subsp. carota 30260	KJ521488	KJ520972	KJ522061	KJ522358	KJ521388	KJ522165	KJ521959	KJ521591	KJ521079	KJ521186
D. carota subsp. gummifer 478883	KJ521491	KJ520975	KJ522063	KJ522361	KJ521391	KJ522168	KJ521961	KJ521594	KJ521082	KJ521189
Daucus conchitae 25832	KU646092	KU646142	N/A	KU646240	KU646291	KU646009	N/A	KU646447	KU646343	KU646396
Daucus conchitae 25835	KU646094	KU646144	KU646194	KU646242	KU646293	KU646011	N/A	N/A	KU646345	KU646398
Daucus conchitae 25848	KU646096	KU646146	KU646196	KU646244	KU646295	KU646013	KU646056	KU646448	KU646347	KU646400
Daucus conchitae 25851	KU646116	KU646169	KU646217	KU646265	KU646318	KU646036	KU646072	KU646469	KU646370	KU646423
Daucus conchitae 25855	KU646122	KU646175	KU646222	KU646271	KU646323	N/A	KU646076	KU646475	KU646376	KU646429
Daucus conchitae 25856	KU646123	KU646176	KU646223	KU646272	KU646324	KU646042	N/A	KU646476	KU646377	KU646430
Daucus conchitae 25864	KU646124	KU646177	N/A	KU646273	KU646325	KU646043	N/A	KU646477	KU646378	KU646431
Daucus conchitae 25865	KU646125	KU646178	KU646224	KU646274	KU646326	KU646044	KU646077	KU646478	KU646379	KU646432
Daucus conchitae 25869	KU646126	KU646179	N/A	KU646275	KU646327	KU646045	KU646078	KU646479	KU646380	KU646433
Daucus conchitae 25876	KU646097	KU646147	KU646197	KU646245	KU646296	KU646014	N/A	KU646449	KU646348	KU646401
Daucus conchitae 25878	KU646098	KU646148	KU646198	KU646246	KU646297	KU646015	N/A	KU646450	KU646349	KU646402
Daucus conchitae 25880	KU646127	KU646180	KU646225	KU646276	KU646328	KU646046	N/A	KU646480	KU646381	KU646434
Daucus conchitae 652366	KU646107	KU646159	N/A	KU646256	KU646308	KU646026	N/A	KU646461	KU646360	KU646413
Daucus conchitae 652367	KJ521474	KJ520958	KJ522047	KJ522344	KJ521374	KJ522151	KJ521946	KJ521577	KJ521065	KJ521172

1											
2	Daucus conchitae 652371	KU646108	KU646160	N/A	KU646257	KU646309	KU646027	KU646067	KU646462	KU646361	KU646414
3	Daucus conchitae 652375	KJ521520	KJ521004	N/A	KJ522390	KJ521419	KJ522196	N/A	KJ521623	KJ521111	KJ521218
4	Daucus conchitae 652385	KU646085	KU646134	KU646185	KU646232	KU646283	KU646003	N/A	KU646440	KU646335	KU646388
5	Daucus conchitae 652386	KU646109	KU646161	KU646209	KU646258	KU646310	KU646028	KU646068	KU646463	KU646362	KU646415
6											
7	Daucus crinitus 33833 s	MK254474	MK254189	MK254151	MK254352	MK254311	MK254393	MK254514	MK254229	MK254270	MK254434
8	Daucus crinitus 33834 s	MK254475	MK254190	MK254152	MK254353	MK254312	MK254394	MK254515	MK254230	MK254271	MK254435
9	Daucus crinitus 33835 s	MK254476	MK254191	MK254153	MK254354	MK254313	MK254395	MK254516	MK254231	MK254272	MK254436
10	Daucus crinitus 33836 s	MK254477	MK254192	MK254154	MK254355	MK254314	MK254396	MK254517	MK254232	MK254273	MK254437
11	Daucus crinitus 33838 s	MK254478	MK254193	MK254155	MK254356	MK254315	MK254397	MK254518	MK254233	MK254274	MK254438
12											
13	Daucus crinitus 652414	KJ521496	KJ520980	KJ522068	KJ522366	KJ521395	KJ522173	KJ521966	KJ521599	KJ521087	KJ521194
14	Daucus durieua 33839 s	MK254479	MK254194	MK254156	MK254357	MK254316	MK254398	MK254519	MK254234	MK254275	MK254439
15	Daucus durieua 33840 s	MK254480	MK254195	MK254157	MK254358	MK254317	MK254399	MK254520	MK254235	MK254276	MK254440
16	Daucus durieua 33841 s	MK254481	MK254196	MK254158	MK254359	MK254318	MK254400	MK254521	MK254236	MK254277	MK254441
17	Daucus durieua 33842 s	MK254482	MK254197	MK254159	MK254360	MK254319	MK254401	MK254522	MK254237	MK254278	MK254442
18	Daucus durieua 33845 s	MK254483	MK254198	MK254160	MK254361	MK254320	MK254402	MK254523	MK254238	MK254279	MK254443
19	Daucus durieua 33846 s	MK254484	MK254199	MK254161	MK254362	MK254321	MK254403	MK254524	MK254239	MK254280	MK254444
20											
21	Daucus glochidiatus 285038	KJ521504	KJ520988	KJ522076	KJ522374	KJ521403	KJ522180	KJ521973	KJ521607	KJ521095	KJ521202
22	D. glochidiatus HRIGRU8251 e	MK254485	MK254200	MK254162	MK254363	MK254322	MK254404	MK254525	MK254240	MK254281	MK254445
23	D. gracilis HRIGRU6677 e	MK254486	MK254201	MK254163	MK254364	MK254323	MK254405	MK254526	MK254241	MK254282	MK254446
24											
25	Daucus guttatus 1303 f	MK254473	MK254188	MK254150	MK254351	MK254310	MK254392	MK254513	MK254228	MK254269	MK254433
26	Daucus guttatus 25714	KU646086	KU646136	KU646187	KU646234	KU646285	KU646005	KU646050	KU646442	KU646337	KU646390
27	Daucus guttatus 25721	KU646087	KU646137	KU646188	KU646235	KU646286	KU646006	KU646051	KU646443	KU646338	KU646391
28	Daucus guttatus 25722	KU646120	KU646173	KU646220	KU646269	KU646321	KU646040	KU646074	KU646473	KU646374	KU646427
29	Daucus guttatus 25724	KU646113	KU646166	KU646214	KU646263	KU646315	KU646033	KU646071	KU646468	KU646367	KU646420
30	Daucus guttatus 25729	KU646088	KU646138	KU646189	KU646236	KU646287	N/A	KU646052	KU646444	KU646339	KU646392
31	Daucus guttatus 25733	KU646089	KU646139	KU646190	KU646237	KU646288	KU646007	KU646053	N/A	KU646340	KU646393
32	Daucus guttatus 25755	KU646090	KU646140	KU646191	KU646238	KU646289	KU646008	KU646054	KU646445	KU646341	KU646394
33	Daucus guttatus 25772	KU646121	KU646174	KU646221	KU646270	KU646322	KU646041	KU646075	KU646474	KU646375	KU646428
34	Daucus guttatus 25885	KU646128.1	KU646181	KU646226	KU646277	KU646329	KU646047	KU646079	KU646481	KU646382	KU646435
35											
36	Daucus guttatus 25898	KJ521523	KJ521008	KJ522095	KJ522393	KJ521423	KJ522200	KJ521992	KJ521627	KJ521115	KJ521222
37	Daucus guttatus 279763	KJ521509	KJ520993	KJ522081	KJ522379	KJ521408	KJ522185	KJ521978	KJ521612	KJ521100	KJ521207
38	Daucus guttatus 286611	KJ521482	KJ520966	KJ522055	KJ522352	KJ521382	N/A	N/A	KJ521585	KJ521073	KJ521180
39	Daucus guttatus 295858	KU646099	KU646149	KU646199	KU646247	KU646298	KU646016	KU646057	KU646451	KU646350	KU646403
40	Daucus guttatus 652233	KJ521471	KJ520955	KJ522044	KJ522341	KJ521371	KJ522148	N/A	KJ521574	KJ521062	KJ521169
41	Daucus guttatus 652339	KU646105	KU646157	KU646207	KU646254	KU646306	KU646024	KU646065	KU646459	KU646358	KU646411
42											
43											
44											
45											
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47											

1											
2	<i>Daucus guttatus</i> 652340	KJ521473	KJ520957	KJ522046	KJ522343	KJ521373	KJ522150	KJ521945	KJ521576	KJ521064	KJ521171
3	<i>Daucus guttatus</i> 652342	KU646083	KU646132	N/A	KU646230	KU646281	KU646001	N/A	KU646438	KU646333	KU646386
4	<i>Daucus guttatus</i> 652343	KJ521511	KJ520995	KJ522083	KJ522381	KJ521410	KJ522187	KJ521980	KJ521614	KJ521102	KJ521209
5	<i>Daucus guttatus</i> 652345	KU646084	KU646133	KU646184	KU646231	KU646282	KU646002	N/A	KU646439	KU646334	KU646387
6	<i>Daucus guttatus</i> 652387	KJ521501	KJ520985	KJ522073	KJ522371	KJ521400	KJ522177	KJ521970	KJ521604	KJ521092	KJ521199
7	<i>Daucus involucratus</i> 652332	KJ521515	KJ520999	KJ522087	KJ522385	KJ521414	KJ522191	KJ521984	KJ521618	KJ521106	KJ521213
8	<i>Daucus involucratus</i> 652350	KJ521516	KJ521000	KJ522088	KJ522386	KJ521415	KJ522192	KJ521985	KJ521619	KJ521107	KJ521214
9	<i>Daucus involucratus</i> 652355	KJ521517	KJ521001	KJ522089	KJ522387	KJ521416	KJ522193	KJ521986	KJ521620	KJ521108	KJ521215
10	<i>Daucus littoralis</i> 295857	KJ521518	KJ521002	KJ522090	KJ522388	KJ521417	KJ522194	KJ521987	KJ521621	KJ521109	KJ521216
11	<i>Daucus littoralis</i> 341902	KJ521519	KJ521003	KJ522091	KJ522389	KJ521418	KJ522195	KJ521988	KJ521622	KJ521110	KJ521217
12	<i>Daucus montanus</i> 816 f A	MK254487	MK254202	N/A	MK254365	MK254324	MK254406	MK254527	MK254242	MK254283	MK254447
13	<i>Daucus montanus</i> 816 f B	N/A	N/A	N/A	MK254366	MK254325	MK254407	N/A	MK254243	MK254284	N/A
14	<i>Daucus muricatus</i> 29090	KJ521534	KJ521019	KJ522106	KJ522404	KJ521434	KJ522211	KJ522003	KJ521638	KJ521126	KJ521233
15	<i>Daucus muricatus</i> 33850 s	MK254488	MK254203	MK254164	MK254367	MK254326	MK254408	MK254528	MK254244	MK254285	MK254448
16	<i>Daucus muricatus</i> 33851 s	MK254489	MK254204	MK254165	MK254368	MK254327	MK254409	N/A	MK254245	MK254286	MK254449
17	<i>Daucus muricatus</i> 33852 s	MK254490	MK254205	MK254166	MK254369	MK254328	MK254410	MK254529	MK254246	MK254287	MK254450
18	<i>Daucus muricatus</i> 33853 s	MK254491	MK254206	MK254167	MK254370	MK254329	MK254411	MK254530	MK254247	MK254288	MK254451
19	<i>Daucus pusillus</i> 349267	KJ521537	KJ521023	KJ522110	KJ522407	KJ521437	KJ522214	KJ522006	KJ521642	KJ521130	KJ521236
20	<i>Daucus pusillus</i> 661242	KJ521538	KJ521024	KJ522111	KJ522408	KJ521438	KJ522215	KJ522007	KJ521643	KJ521131	KJ521237
21	<i>Daucus pusillus</i> 661256	KJ521539	KJ521025	KJ522112	KJ522409	KJ521439	KJ522216	KJ522008	KJ521644	KJ521132	KJ521238
22	<i>Daucus syrticus</i> 29096	KJ521540	KJ521026	KJ522113	KJ522410	KJ521440	KJ522217	KJ522009	KJ521645	KJ521133	KJ521239
23	<i>Daucus setifolius</i> 33891 s	MK254492	MK254207	MK254168	MK254371	MK254330	MK254412	MK254531	MK254248	MK254289	MK254452
24	<i>Daucus junceus</i> 33890 s	MK254493	MK254208	MK254169	MK254372	MK254331	MK254413	MK254532	MK254249	MK254290	MK254453
25	<i>Daucus junceus</i> 33893 s	MK254494	MK254209	MK254170	MK254373	MK254332	MK254414	MK254533	MK254250	MK254291	MK254454
26	<i>Daucus setulosus</i> 25602	KU646117	KU646170	KU646218	KU646266	KU646319	KU646037	KU646073	KU646470	KU646371	KU646424
27	<i>Daucus setulosus</i> 25605	KU646118	KU646171	KU646219	KU646267	N/A	KU646038	N/A	KU646471	KU646372	KU646425
28	<i>Daucus setulosus</i> 25607	KU646110	KU646162	KU646210	KU646259	KU646311	KU646029	N/A	KU646464	KU646363	KU646416
29	<i>Daucus setulosus</i> 25608	KU646111	KU646163	KU646211	KU646260	KU646312	KU646030	N/A	KU646465	KU646364	KU646417
30	<i>Daucus setulosus</i> 25609	N/A	KU646164	KU646212	KU646261	KU646313	KU646031	KU646069	KU646466	KU646365	KU646418
31	<i>Daucus setulosus</i> 25634	KU646112	KU646165	KU646213	KU646262	KU646314	KU646032	KU646070	KU646467	KU646366	KU646419
32	<i>Daucus setulosus</i> 25636	N/A	KU646135	KU646186	KU646233	KU646284	KU646004	N/A	KU646441	KU646336	KU646389
33	<i>Daucus setulosus</i> 25638	KU646119	KU646172	N/A	KU646268	KU646320	KU646039	N/A	KU646472	KU646373	KU646426
34	<i>Daucus setulosus</i> 25814	KU646091	KU646141	KU646192	KU646239	KU646290	N/A	KU646055	KU646446	KU646342	KU646395
35	<i>Daucus setulosus</i> 652324	KU646101	KU646151	KU646201	KU646248	KU646300	KU646018	KU646059	KU646453	KU646352	KU646405
36	<i>Daucus setulosus</i> 652325	N/A	KU646152	KU646202	KU646249	KU646301	KU646019	KU646060	KU646454	KU646353	KU646406
37											
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2	Daucus setulosus 652326	N/A	KU646153	KU646203	KU646250	KU646302	KU646020	KU646061	KU646455	KU646354	KU646407
3	Daucus setulosus 652327	KU646102	KU646154	KU646204	KU646251	KU646303	KU646021	KU646062	KU646456	KU646355	KU646408
4	Daucus setulosus 652328	KU646103	KU646155	KU646205	KU646252	KU646304	KU646022	KU646063	KU646457	KU646356	KU646409
5	Daucus setulosus 652329	KJ521472	KJ520956	KJ522045	KJ522342	KJ521372	KJ522149	KJ521944	KJ521575	KJ521063	KJ521170
6	Daucus setulosus 652330	KU646104	KU646156	KU646206	KU646253	KU646305	KU646023	KU646064	KU646458	KU646357	KU646410
7	Daucus setulosus 652331	KJ521510	KJ520994	KJ522082	KJ522380	KJ521409	KJ522186	KJ521979	KJ521613	KJ521101	KJ521208
9	Daucus setulosus 652333	KU646082	KU646131	N/A	KU646229	KU646280	KU646000	KU646049	N/A	KU646332	KU646385
10	Daucus setulosus 652360	KJ521512	KJ520996	KJ522084	KJ522382	KJ521411	KJ522188	KJ521981	KJ521615	KJ521103	KJ521210
11	Daucus syrticus 29109	KJ521560	KJ521047	KJ522134	KJ522430	KJ521461	KJ522238	KJ522030	KJ521665	KJ521154	KJ521260
12	Daucus tenuisectus 31616	KJ521561	KJ521049	KJ522136	N/A	KJ521463	KJ522240	KJ522032	KJ521667	KJ521156	KJ521262
13	Daucus decipiens 1306 f	MK254495	MK254210	MK254171	MK254374	MK254333	MK254415	MK254534	MK254251	MK254292	MK254455
15	Daucus edulis 1307 f	MK254496	MK254211	MK254172	MK254375	MK254334	MK254416	MK254535	MK254252	MK254293	MK254456
16	Orlaya daucoides 649477	KJ521498	KJ520982	KJ522070	KJ522368	KJ521397	KJ522174	N/A	KJ521601	KJ521089	KJ521196
17	Daucus minusculus 33854 s	MK254497	MK254212	MK254173	MK254376	MK254335	MK254417	MK254536	MK254253	MK254294	MK254457
18	Daucus minusculus 33855 s	MK254498	MK254213	MK254174	MK254377	MK254336	MK254418	MK254537	MK254254	MK254295	MK254458
19	Daucus pumilis 33856 s	MK254499	MK254214	MK254175	MK254378	MK254337	MK254419	MK254538	MK254255	MK254296	MK254459
21	Daucus pumilis 33858 s	MK254500	MK254215	MK254176	MK254379	MK254338	MK254420	MK254539	MK254256	MK254297	MK254460
22	Daucus pumilis 33859 s	MK254501	MK254216	MK254177	MK254380	MK254339	MK254421	MK254540	MK254257	MK254298	MK254461
23	Daucus pumilis 33861 s	MK254502	MK254217	MK254178	MK254381	MK254340	MK254422	MK254541	MK254258	MK254299	MK254462
24	Daucus pumilis 817 f	MK254503	MK254218	MK254179	MK254382	MK254341	MK254423	MK254542	MK254259	MK254300	MK254463
25	Daucus rouyi 674284	KJ521531	KJ521016	KJ522103	KJ522401	KJ521431	KJ522208	KJ522000	KJ521635	KJ521123	KJ521230
26	Daucus annuus 819 f	MK254504	MK254219	MK254180	MK254383	MK254342	MK254424	MK254543	MK254260	MK254301	MK254464
27	Daucus tenuissimus 818 f	MK254505	MK254220	MK254181	MK254384	MK254343	MK254425	MK254544	MK254261	MK254302	MK254465
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Supplementary file 2. Number of alleles (missing red, one white, 2 yellow) in each of the 10 conserved orthologous sequences examined here.

Accession	10366	3374	3902	10966	15347	16308	16577	16645	32914	35097	% missing "A"	% missing "B"
1 <i>Athamanta sicula</i> 1301_f	1	1	1	0	1	1	1	1	1	1	16.9	16.95
2 <i>Daucus arcanus</i> 33768_s	1	1	1	1	1	1	1	1	1	1	2.87	2.89
3 <i>Daucus aureus</i> 295854	1	1	1	1	1	1	1	1	1	1	0.43	0.44
4 <i>Daucus aureus</i> 33769_s	2	1	1	1	1	1	1	1	1	1	6.04	5.44
5 <i>Daucus aureus</i> 33770_s	1	1	1	1	1	2	1	1	1	1	6.19	6.19
6 <i>Daucus aureus</i> 33771_s	1	1	1	1	1	1	1	2	1	1	8.2	8.26
7 <i>Daucus aureus</i> 33772_s	1	1	1	1	1	1	1	1	1	1	5.95	5.99
8 <i>Daucus aureus</i> 33773_s	2	1	1	1	1	1	1	1	1	1	3.7	3.74
9 <i>Daucus bicolor</i> 25807	1	1	0	1	1	0	1	1	1	0	40.15	40.34
10 <i>Daucus bicolor</i> 25830	1	1	0	1	1	1	1	1	1	0	23.97	24.14
11 <i>Daucus bicolor</i> 25833	1	1	0	1	1	1	1	1	1	0	24.92	25.09
12 <i>Daucus bicolor</i> 25846	1	1	0	1	1	1	1	1	1	0	23.82	23.99
13 <i>Daucus bicolor</i> 25892	1	1	1	1	1	1	1	1	1	0	16.77	16.89
14 <i>Daucus bicolor</i> 25894	1	0	1	1	1	1	1	1	1	0	26.1	25.73
15 <i>Daucus bicolor</i> 652321	1	1	1	1	1	0	1	1	1	1	27.37	27.47
16 <i>Daucus bicolor</i> 652365	1	1	1	1	1	1	1	1	1	1	3.08	3.1
17 <i>Daucus guttatus</i> 1303_f'	1	2	1	1	1	1	1	2	1	2	3.49	3.5
18 <i>Daucus carota</i> subsp. <i>capillifolius</i> 30198	1	1	1	1	1	1	1	1	1	1	0.18	0.18
19 <i>Daucus carota</i> subsp. <i>carota</i> 30260	1	1	1	1	1	1	1	1	1	1	0.18	0.18
20 <i>Daucus carota</i> subsp. <i>gummifer</i> 478883	1	1	1	1	1	1	1	1	1	1	0.18	0.18
21 <i>Daucus conchitae</i> 25832	1	1	0	1	0	1	1	1	1	1	24.42	24.59
22 <i>Daucus conchitae</i> 25835	1	1	0	1	1	1	1	1	1	0	28.39	28.59
23 <i>Daucus conchitae</i> 25848	1	1	1	1	1	1	1	1	1	1	7.98	8.04
24 <i>Daucus conchitae</i> 25851	1	1	1	1	1	1	1	1	1	1	4.04	4.07
25 <i>Daucus conchitae</i> 25855	1	0	1	1	1	1	1	1	1	1	24.05	23.67
26 <i>Daucus conchitae</i> 25856	1	1	0	1	1	1	1	1	1	1	17.54	17.67
27 <i>Daucus conchitae</i> 25864	1	1	0	1	0	1	1	1	1	1	23.24	23.4
28 <i>Daucus conchitae</i> 25865	1	1	1	1	1	1	1	1	1	1	5.27	5.31
29 <i>Daucus conchitae</i> 25869	1	1	1	1	0	1	1	1	1	1	16.48	16.6
30 <i>Daucus conchitae</i> 25876	1	1	0	1	1	1	1	1	1	1	18.3	18.43
31 <i>Daucus conchitae</i> 25878	1	1	0	1	1	1	1	1	1	1	17.97	18.1
32 <i>Daucus conchitae</i> 25880	1	1	0	1	1	1	1	1	1	1	17.58	17.7
33 <i>Daucus conchitae</i> 652366	1	1	0	1	0	1	1	1	1	1	22.87	23.04
34 <i>Daucus conchitae</i> 652367	1	1	1	1	1	1	1	1	1	1	0.17	0.18
35 <i>Daucus conchitae</i> 652371	1	1	1	1	0	1	1	1	1	1	17.68	17.81
36 <i>Daucus conchitae</i> 652375	1	1	0	1	0	1	1	1	1	1	20.74	20.89

Accession	10366	3374	3902	10966	15347	16308	16577	16645	32914	35097	% missing "A"	% missing "B"
Daucus_conchitae_652385	1	1	0	1	1	1	1	1	1	1	23.61	23.78
Daucus_conchitae_652386	1	1	1	1	1	1	1	1	1	1	6.33	6.38
Daucus crinitus 33833_s	1	1	1	1	2	1	1	1	1	1	6.64	6.77
Daucus crinitus 33834_s	1	1	1	1	2	1	1	1	1	1	7.16	7.21
Daucus crinitus 33835_s	1	1	2	1	1	1	1	1	1	1	9	12.6
Daucus crinitus 33836_s	1	1	1	1	1	1	1	1	1	1	7.26	7.31
Daucus crinitus 33838_s	1	1	1	1	1	1	1	1	1	1	4.91	4.95
Daucus crinitus_652414	1	1	1	1	1	1	1	1	1	1	0.95	0.95
Daucus durieua 33839_s	1	1	1	1	1	1	1	1	1	1	2.59	2.61
Daucus durieua 33840_s	1	1	1	1	1	1	1	1	1	1	3.09	3.11
Daucus durieua 33841_s	1	1	1	1	1	1	1	1	1	1	2.9	2.93
Daucus durieua 33842_s	1	1	1	1	1	1	1	1	1	1	2.33	2.35
Daucus durieua 33845_s	1	1	1	1	1	1	1	1	1	1	2.97	2.99
Daucus durieua 33846_s	1	1	1	1	1	1	1	1	1	1	2.82	2.84
Daucus glochidiatus_285038	1	1	1	1	1	1	1	1	1	1	0.32	0.32
Daucus glochidiatus HRIGRU8251_e	2	2	1	1	1	1	1	1	1	2	2.52	2.08
Daucus gracilis HRIGRU6677_e	1	1	1	1	1	1	1	1	1	1	3.93	3.96
Daucus guttatus_25714	1	1	1	1	1	1	1	1	1	1	9.98	10.06
Daucus guttatus_25721	1	1	1	1	1	1	1	1	1	1	3.7	3.72
Daucus guttatus_25722	1	1	1	1	1	1	1	1	1	1	4.64	4.67
Daucus guttatus_25724	1	1	1	1	1	1	1	1	1	1	3.02	3.04
Daucus guttatus_25729	1	0	1	1	1	1	1	1	1	1	13.72	13.27
Daucus guttatus_25733	1	1	1	1	1	1	1	1	1	0	13.75	13.85
Daucus guttatus_25755	1	1	1	1	1	1	1	1	1	1	9.1	9.16
Daucus guttatus_25772	1	1	1	1	1	1	1	1	1	1	4.16	4.19
Daucus guttatus_25885	1	1	1	1	1	1	1	1	1	1	5.36	5.4
Daucus guttatus_25898	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus guttatus_279763	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus guttatus_286611	1	0	0	1	1	1	1	1	1	1	24.44	24.06
Daucus guttatus_295858	1	1	1	1	1	1	1	1	1	1	4.21	4.24
Daucus guttatus_652233	1	1	0	1	1	1	1	1	1	1	14.04	14.15
Daucus guttatus_652339	1	1	1	1	1	1	1	1	1	1	8.16	8.22
Daucus guttatus_652340	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus guttatus_652342	1	1	0	1	0	1	1	1	1	1	23.42	23.59
Daucus guttatus_652343	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus guttatus_652345	1	1	0	1	1	1	1	1	1	1	17.1	17.22
Daucus guttatus_652387	1	1	1	1	1	1	1	1	1	1	0.18	0.18

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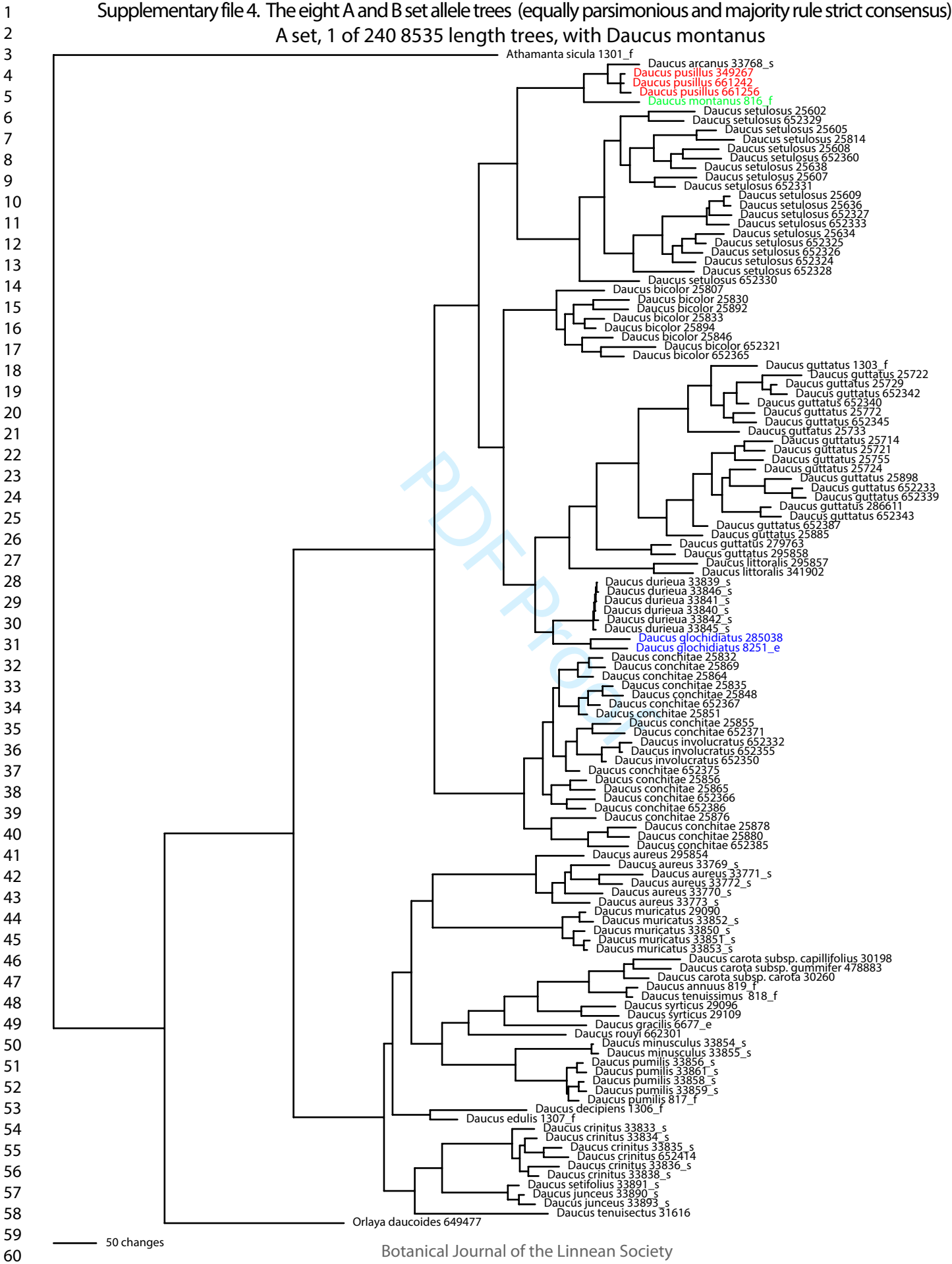
Accession	10366	3374	3902	10966	15347	16308	16577	16645	32914	35097	% missing "A"	% missing "B"
Daucus involucratus_652332	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus involucratus_652350	1	1	1	1	1	1	1	1	1	1	0.17	0.18
Daucus involucratus_652355	1	1	1	1	1	1	1	1	1	1	0.17	0.18
Daucus littoralis_295857	1	1	1	1	1	1	1	1	1	1	0.93	0.94
Daucus littoralis_341902	1	1	1	1	1	1	1	1	1	1	0.72	0.73
Daucus montanus 816_f'	1	2	1	1	0	2	2	2	1	2	12.86	7.78
Daucus muricatus_29090	1	1	1	1	1	1	1	1	1	1	0.44	0.45
Daucus muricatus 33850_s	1	1	1	1	1	1	1	1	1	1	3.45	3.48
Daucus muricatus 33851_s	1	1	0	2	1	1	1	1	1	1	19.53	19.45
Daucus muricatus 33852_s	1	1	1	2	1	1	1	1	1	1	11.15	11.19
Daucus muricatus 33853_s	1	1	1	2	1	1	1	1	1	1	3.26	2.98
Daucus pusillus_349267	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus pusillus_661242	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus pusillus_661256	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus syrticus_29096	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus setifolius long 33891_s	1	1	1	1	1	1	1	1	1	1	4.65	4.69
Daucus setifolius short 33890_s	1	1	1	1	1	1	1	1	1	1	5.1	5.14
Daucus setifolius short 33893_s	1	1	1	1	1	1	1	1	1	1	4.61	4.64
Daucus setulosus_25602	1	1	1	1	1	1	1	1	1	1	12.34	12.43
Daucus setulosus_25605	1	1	0	1	1	1	0	1	1	1	23.25	23.41
Daucus setulosus_25607	1	1	0	1	1	1	1	1	1	1	17.83	17.96
Daucus setulosus_25608	1	1	0	1	1	1	1	1	1	1	16.84	16.97
Daucus setulosus_25609	0	1	1	1	1	1	1	1	1	1	15.61	15.72
Daucus setulosus_25634	1	1	1	1	1	1	1	1	1	1	3.97	3.99
Daucus setulosus_25636	0	1	0	1	1	1	1	1	1	1	27.16	27.35
Daucus setulosus_25638	1	1	0	1	0	1	1	1	1	1	35.24	35.49
Daucus setulosus_25814	1	0	1	1	1	setulosu	1	1	1	1	14.42	13.97
Daucus setulosus_652324	1	1	1	1	1	1	1	1	1	1	4.87	4.9
Daucus setulosus_652325	0	1	1	1	1	1	1	1	1	1	17.15	17.27
Daucus setulosus_652326	0	1	1	1	1	1	1	1	1	1	13.12	13.22
Daucus setulosus_652327	1	1	1	1	1	1	1	1	1	1	8.34	8.4
Daucus setulosus_652328	1	1	1	1	1	1	1	1	1	1	7.74	7.8
Daucus setulosus_652329	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus setulosus_652330	1	1	1	1	1	1	1	1	1	1	3.7	3.72
Daucus setulosus_652331	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus setulosus_652333	1	1	1	1	0	1	1	1	1	0	22.21	22.37
Daucus setulosus_652360	1	1	1	1	1	1	1	1	1	1	0.18	0.18

Accession	10366	3374	3902	10966	15347	16308	16577	16645	32914	35097	% missing "A"	% missing "B"
Daucus_syrcticus_29109	1	1	1	1	1	1	1	1	1	1	0.18	0.18
Daucus_tenuisectus_31616	1	1	1	1	0	0	0	1	1	1	30.85	30.97
Daucus_decipiens_1306_f	1	1	2	2	1	1	1	1	1	1	1.91	1.73
Daucus_edulis_1307_f	1	1	2	1	1	1	1	1	1	1	1.35	1.73
Oxleya_daucoides_649477	1	1	0	1	1	1	1	1	1	1	15.24	15.35
Daucus_minisculus_33854_s	1	1	1	1	1	1	1	1	1	1	3.04	3.07
Daucus_minisculus_33855_s	1	1	1	1	1	1	1	1	1	1	3.33	3.35
Daucus_pumilus_33856_s	1	1	1	1	1	1	1	1	1	1	8.56	8.62
Daucus_pumilus_33858_s	1	1	1	1	1	1	1	1	1	1	3.85	3.88
Daucus_pumilus_33859_s	1	1	1	1	1	1	1	1	1	1	4.22	4.25
Daucus_pumilus_33861_s	1	1	1	1	1	1	1	1	1	1	3.83	3.85
Daucus_pumilus_817_f	1	1	1	1	1	1	1	1	1	1	1.38	1.39
Daucus_rouyi_662301	1	1	1	1	1	1	1	1	1	1	0.12	0.12
Daucus_annuus_819_f	1	1	1	1	1	1	1	1	1	1	1.5	1.51
Daucus_tenuissimus_818_f	1	1	1	2	1	1	1	1	1	1	1.17	1.19
											9.19232	9.20872

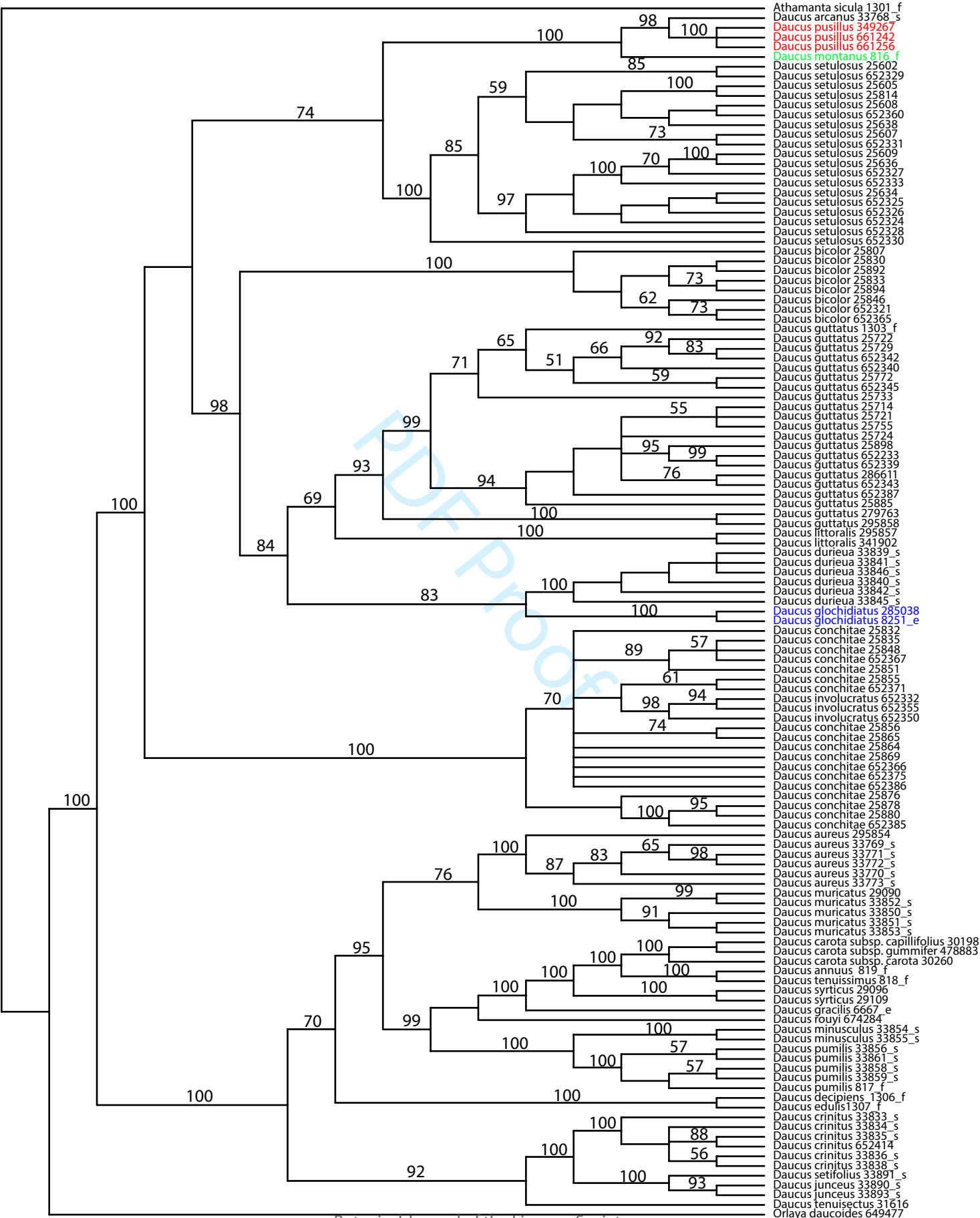
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Supplementary File 3. Tree statistics for the four maximum parsimony analyses of the concatenated 10 nuclear ortholog datasets examined here.

Tree	A set with	A set without	B set with	B set without
Statistic	<i>Daucus</i>	<i>Daucus</i>	<i>Daucus</i>	<i>Daucus</i>
	<i>montanus</i>	<i>montanus</i>	<i>montanus</i>	<i>montanus</i>
Number of trees	240	240	24	48
Tree length	8535	8453	8425	8341
Constant characters	7698	7709	7640	7650
Autapomorphic characters	1380	1374	1375	1368
Parsimony informative characters	2421	2416	2416	2399
Consistency index	0.5987	0.6024	0.6024	0.6066
Consistency index excluding uninformative characters	0.5101	0.5142	0.5136	0.5183
Retention index	0.8690	0.8708	0.8718	0.8737
Rescaled consistency index	0.5203	0.5246	0.5252	0.5300

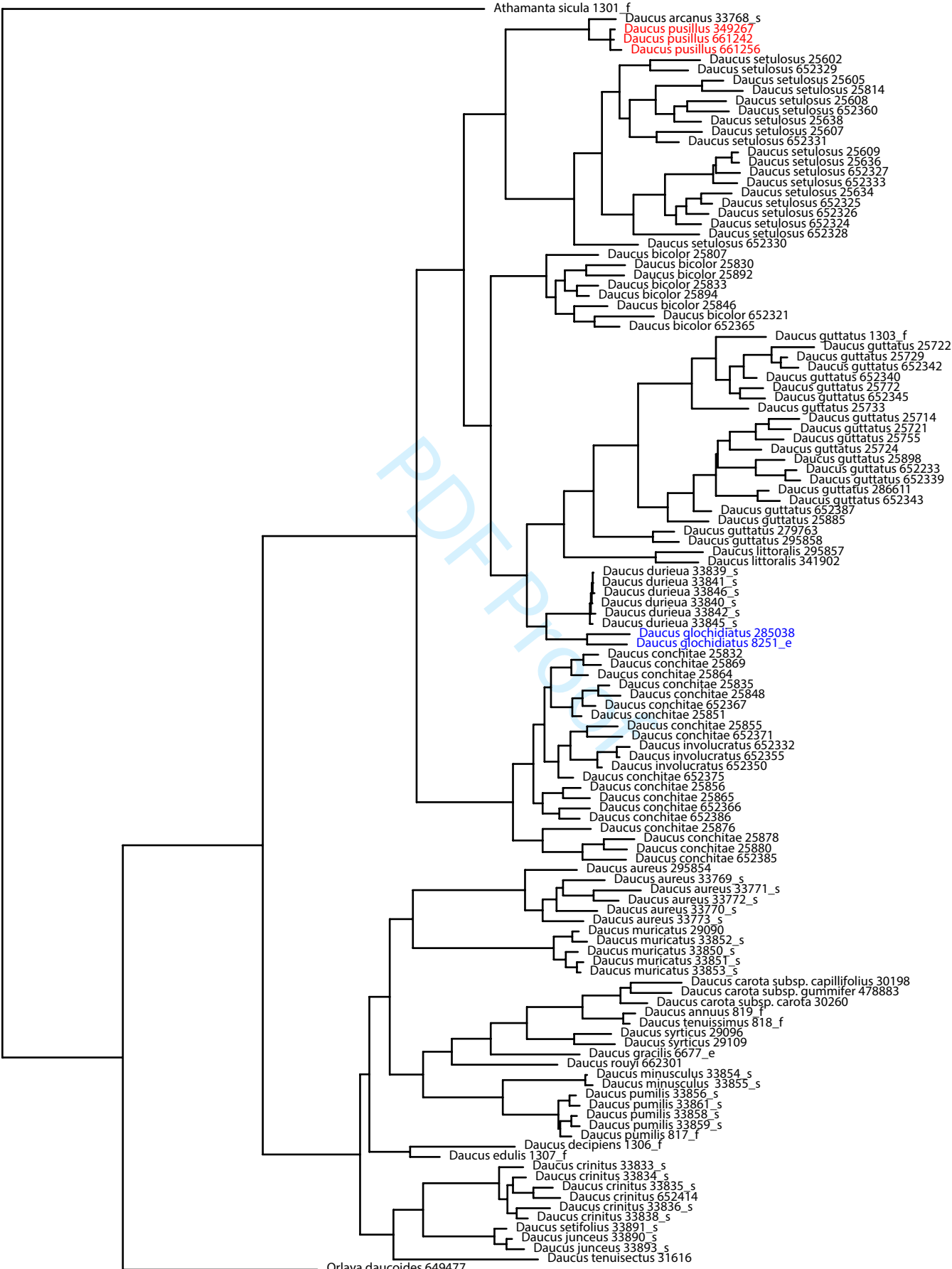


A set, strict consensus of 240, 8534 length trees, with *Daucus montanus*

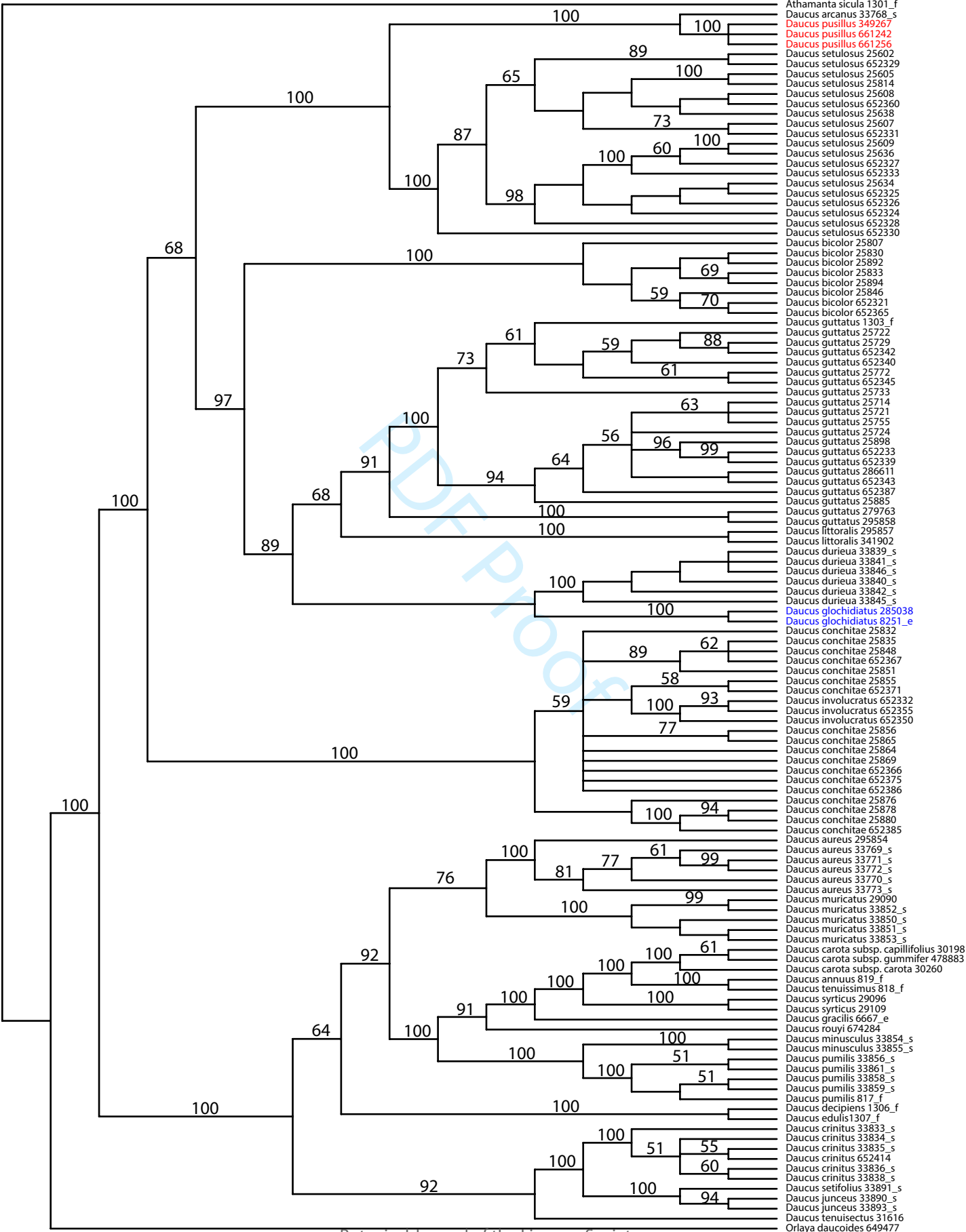


A set, 1 of 240 8453 length trees, without *Daucus montanus*

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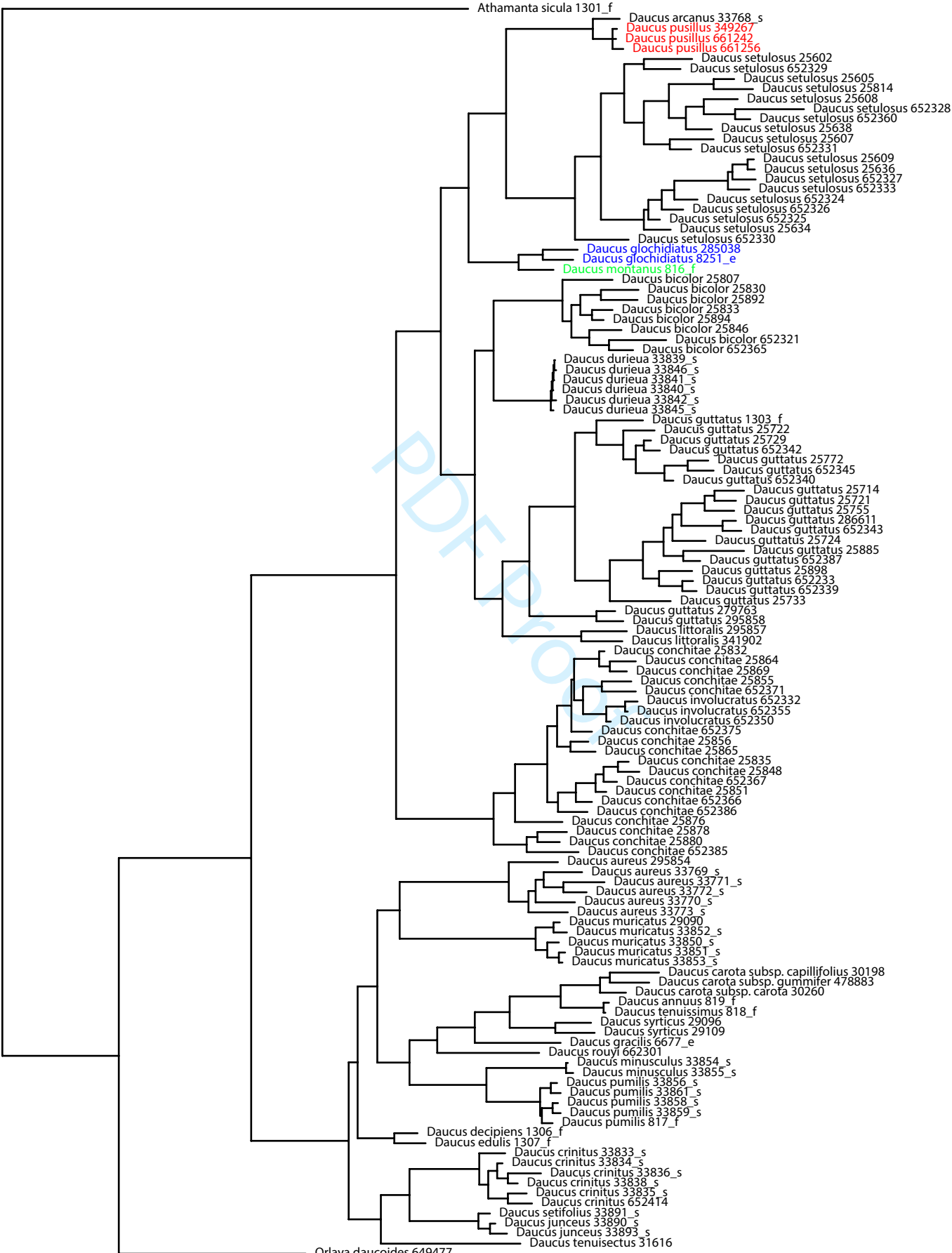


A set, strict consensus of 240, 8453 length trees, without *Daucus montanus*

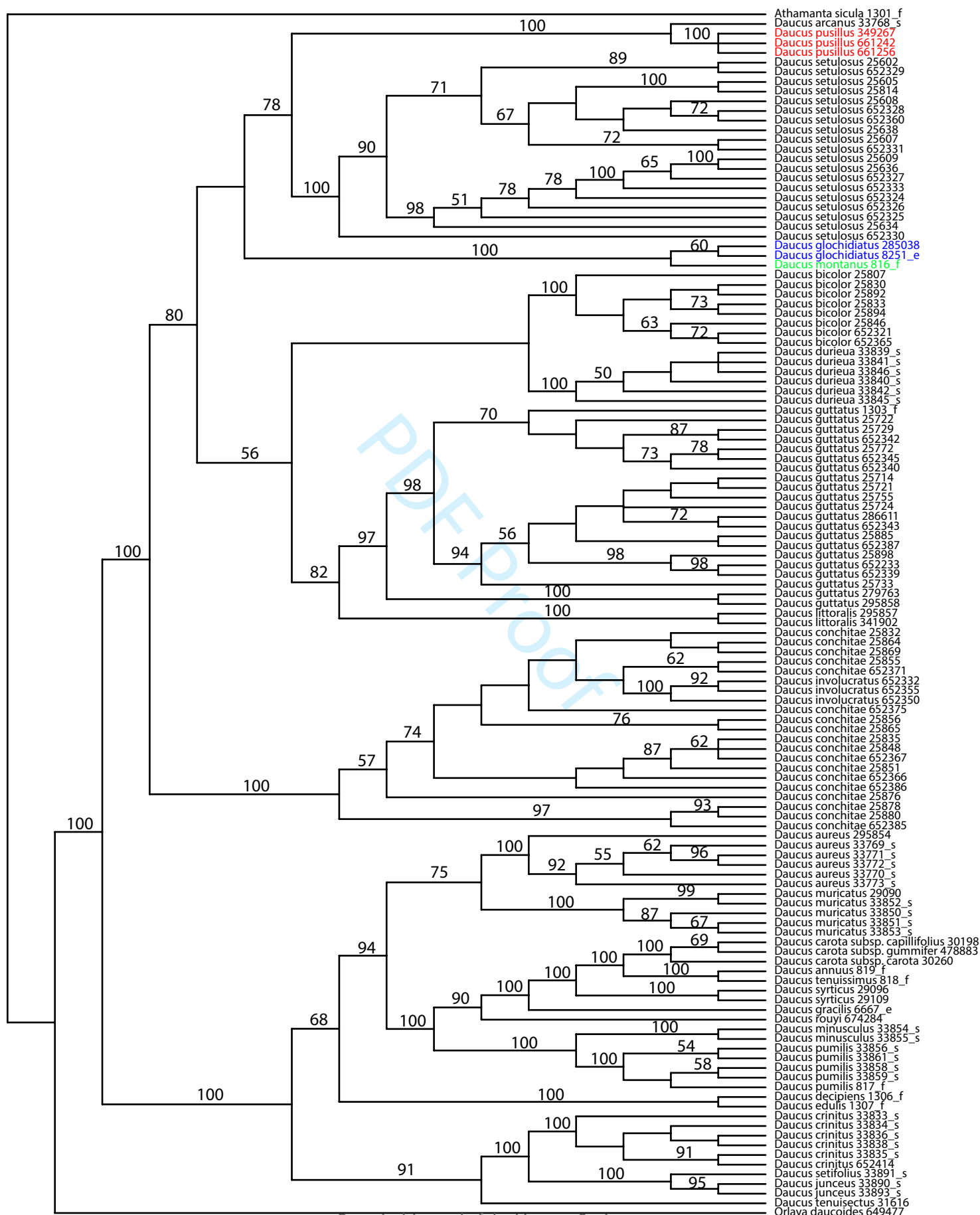


B set, 1 of 24 8425 length trees, with *Daucus montanus*

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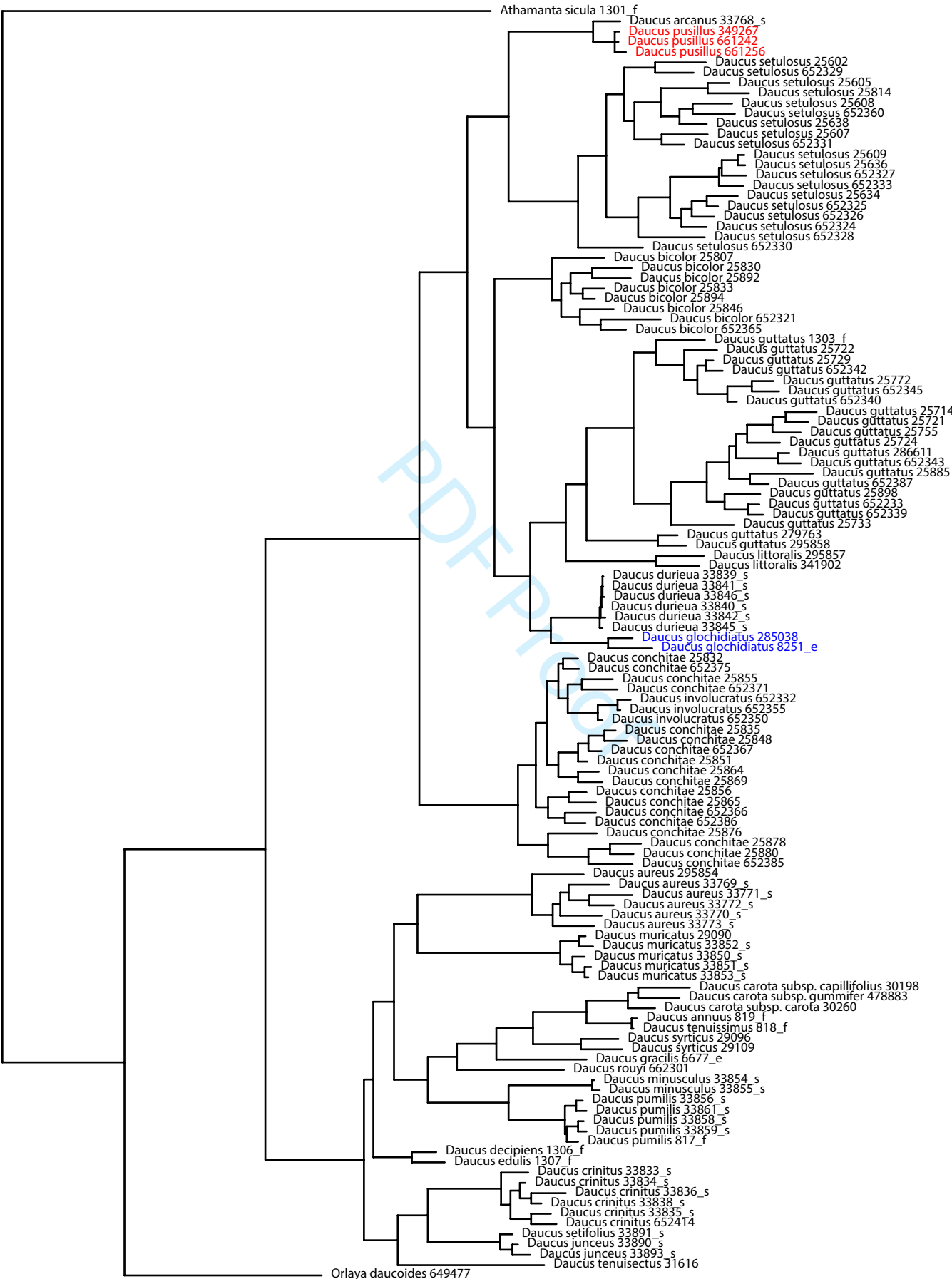


50 changes

B set, strict consensus of 24, 8425 length trees, with *Daucus montanus*

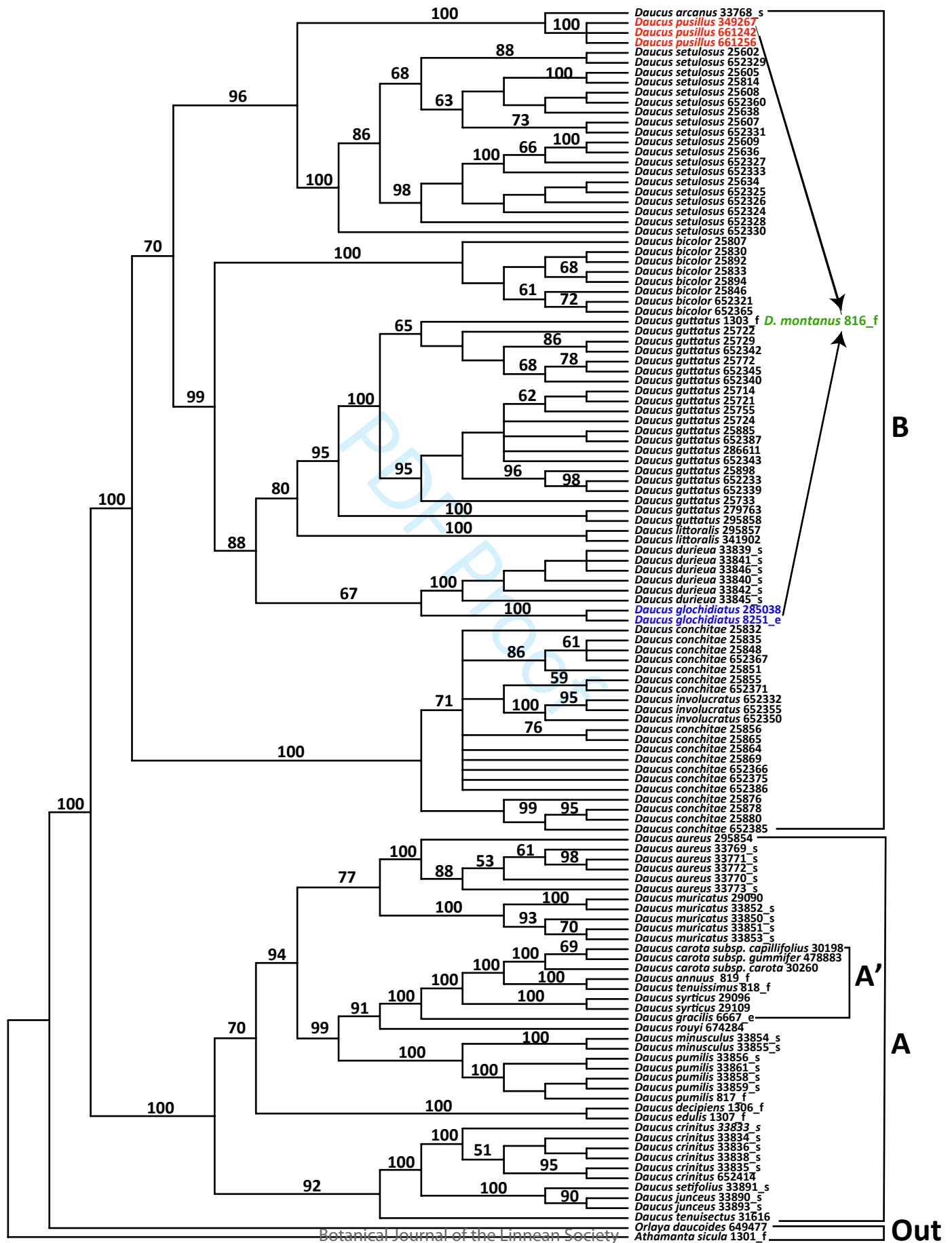
B set, 1 of 72 8341 length trees, without *Daucus montanus*

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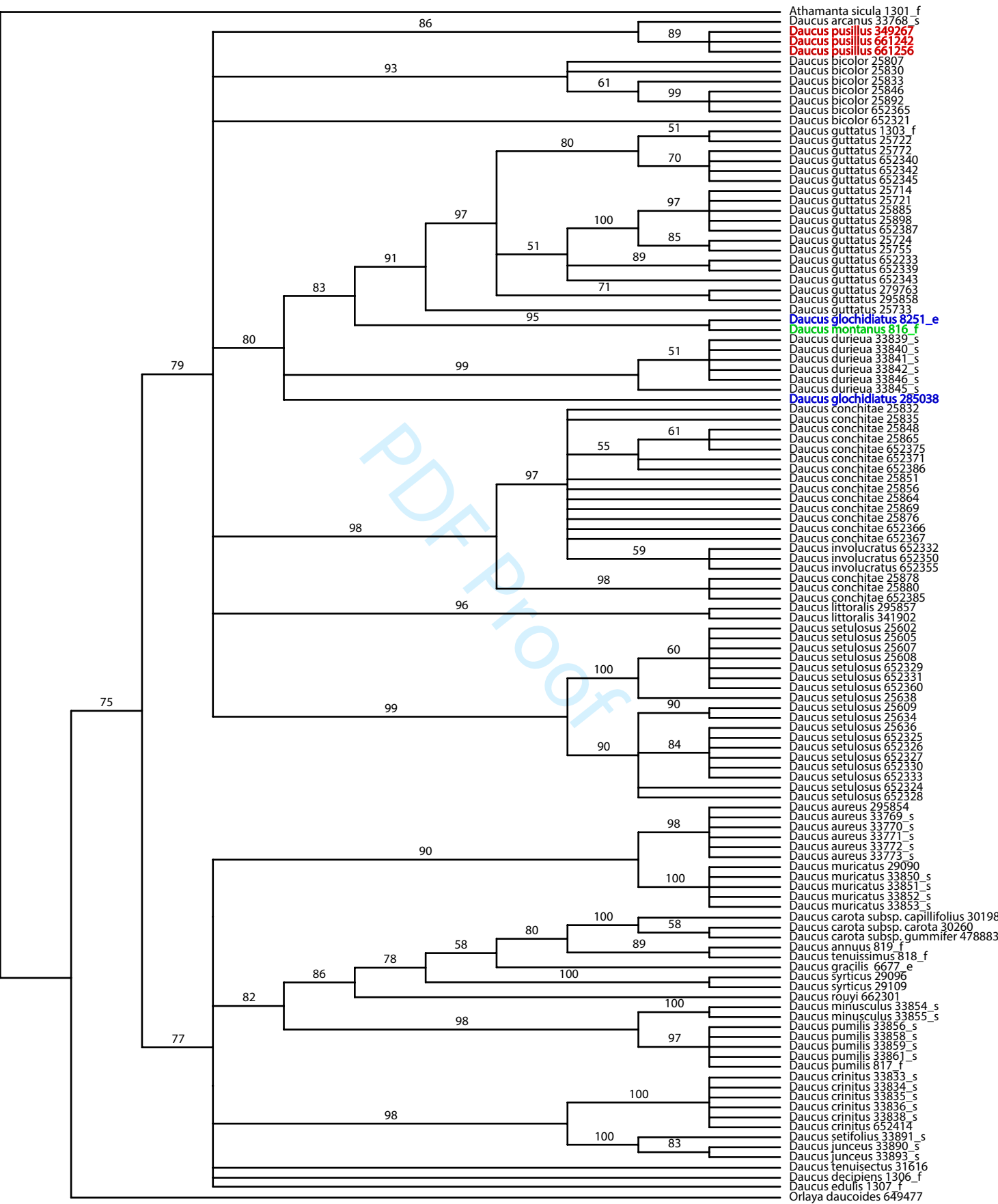
50 changes

B set, maximum parsimony strict consensus of 72, 8425 length trees, without *Daucus montanus*

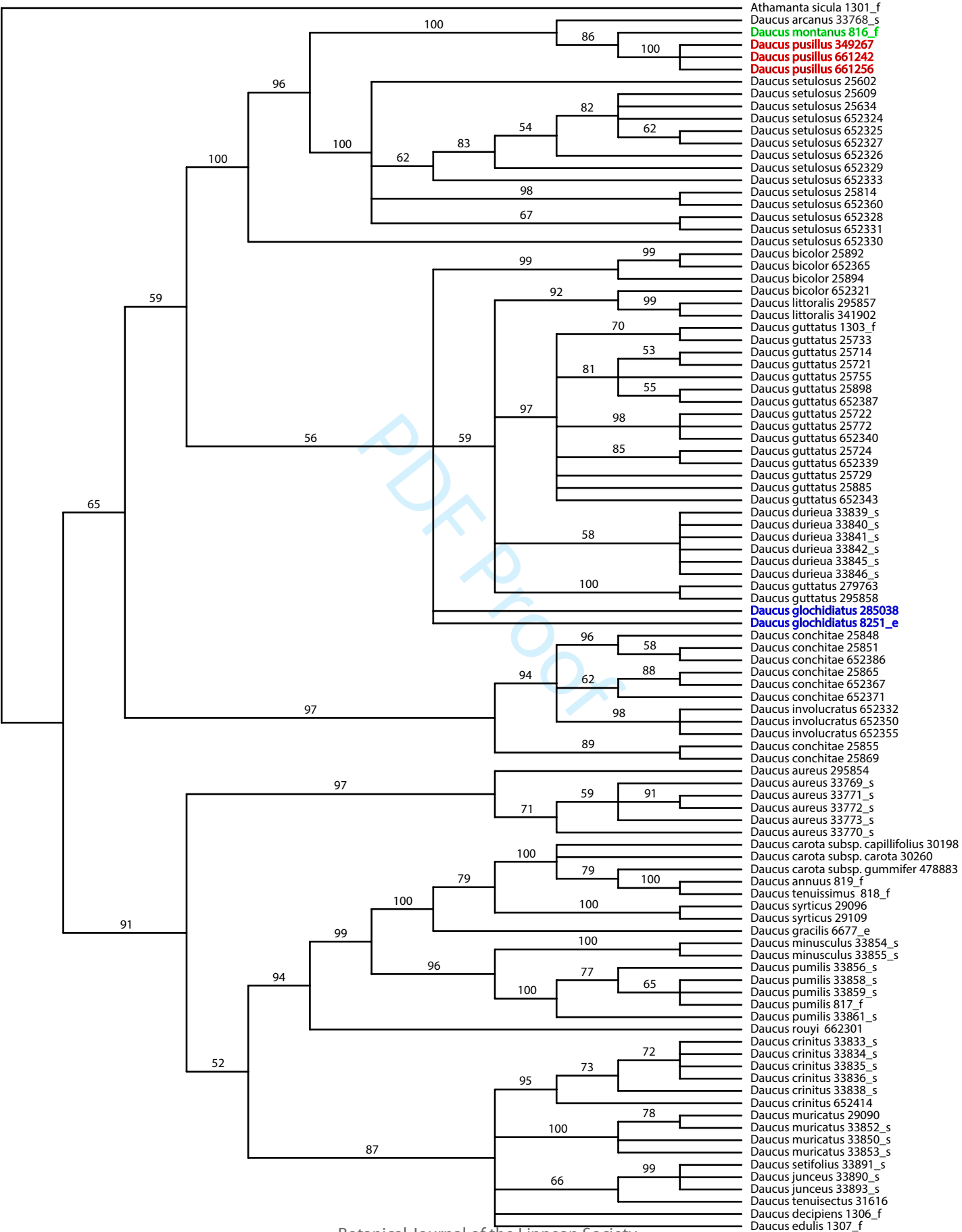


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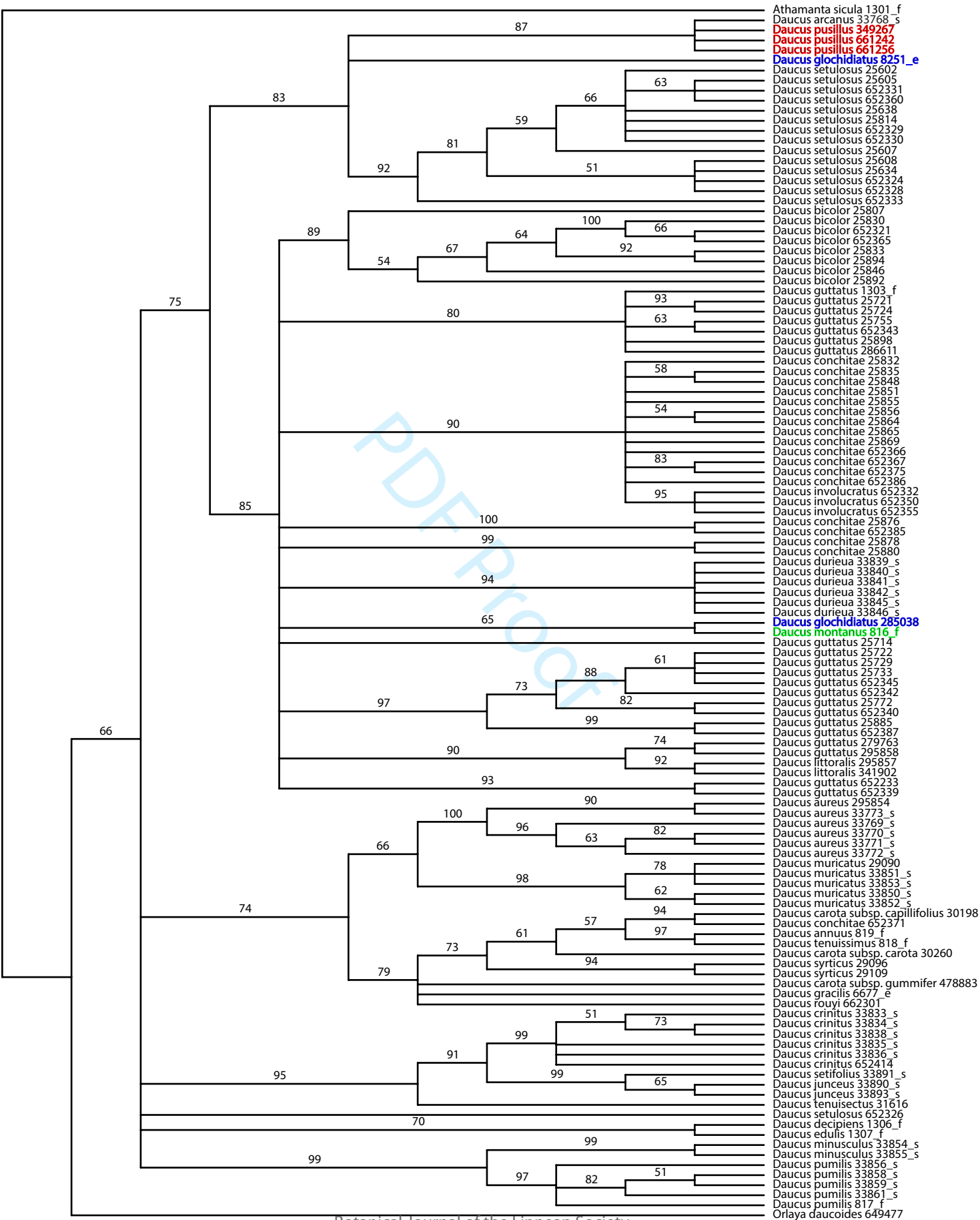
A set, 3374 allele, with *Daucus montanus*, bootstrap consensus tree



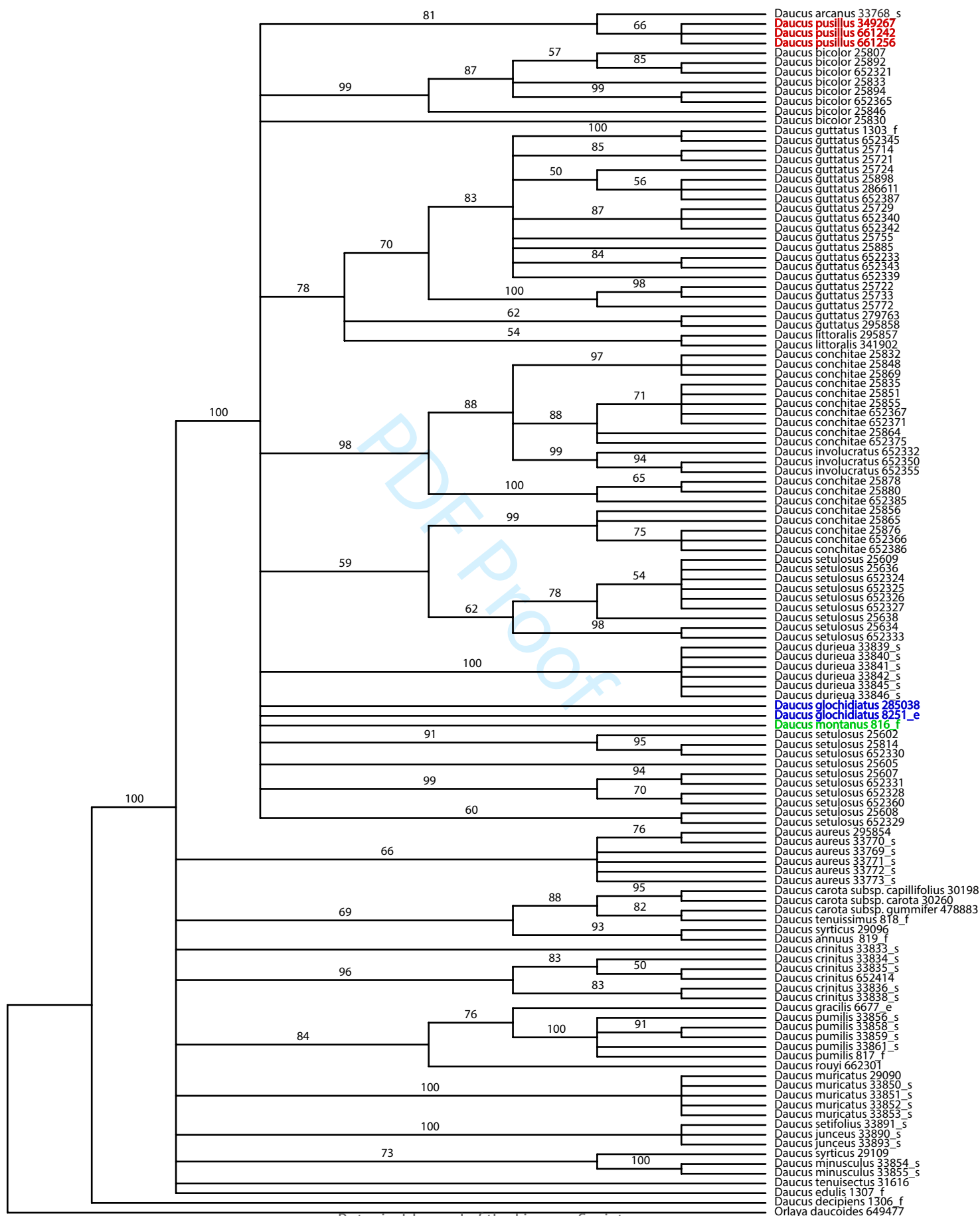
A set, 3902 allele, with *Daucus montanus*, bootstrap consensus tree



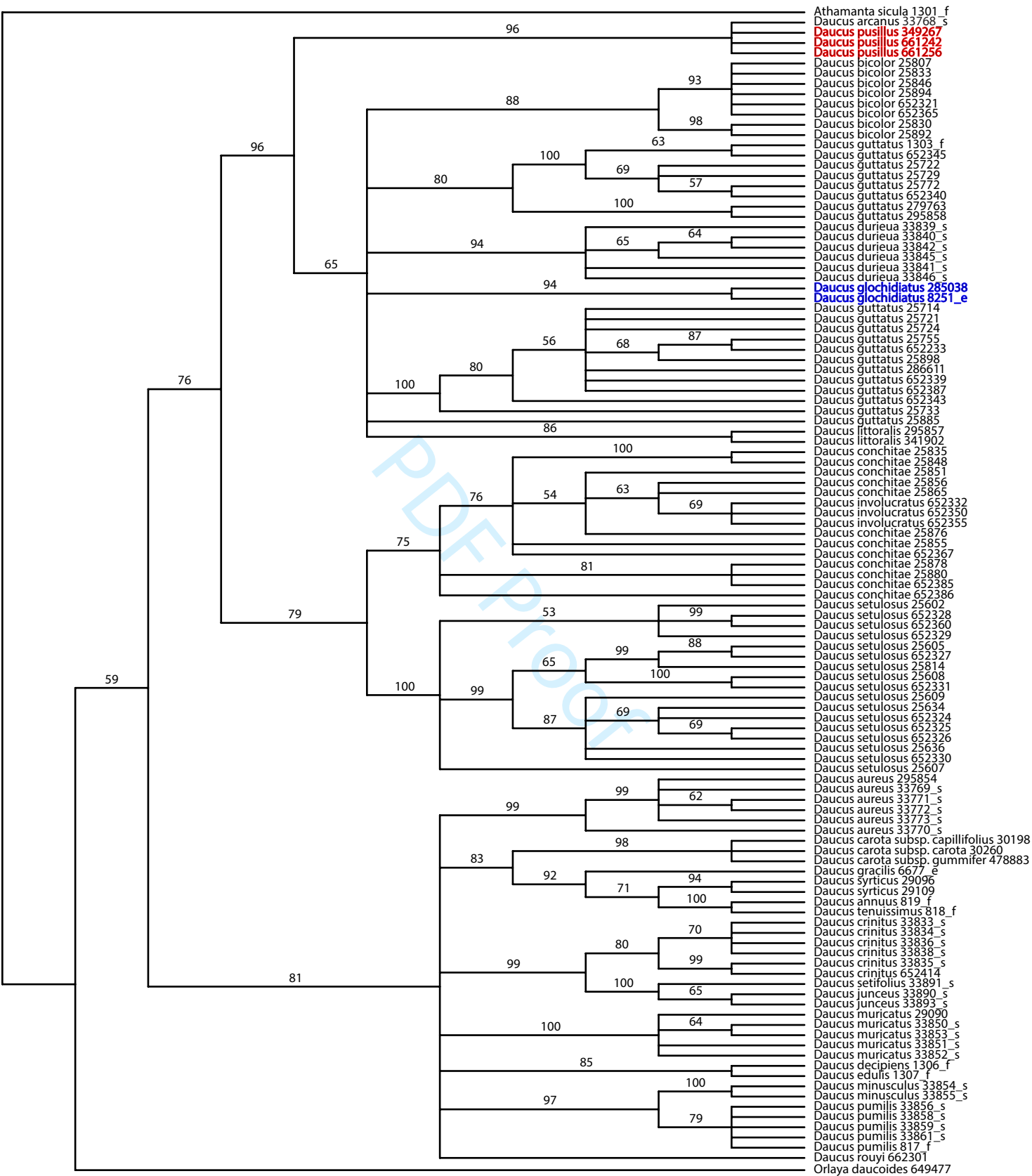
A set, 10366 allele, with *Daucus montanus*, bootstrap consensus tree



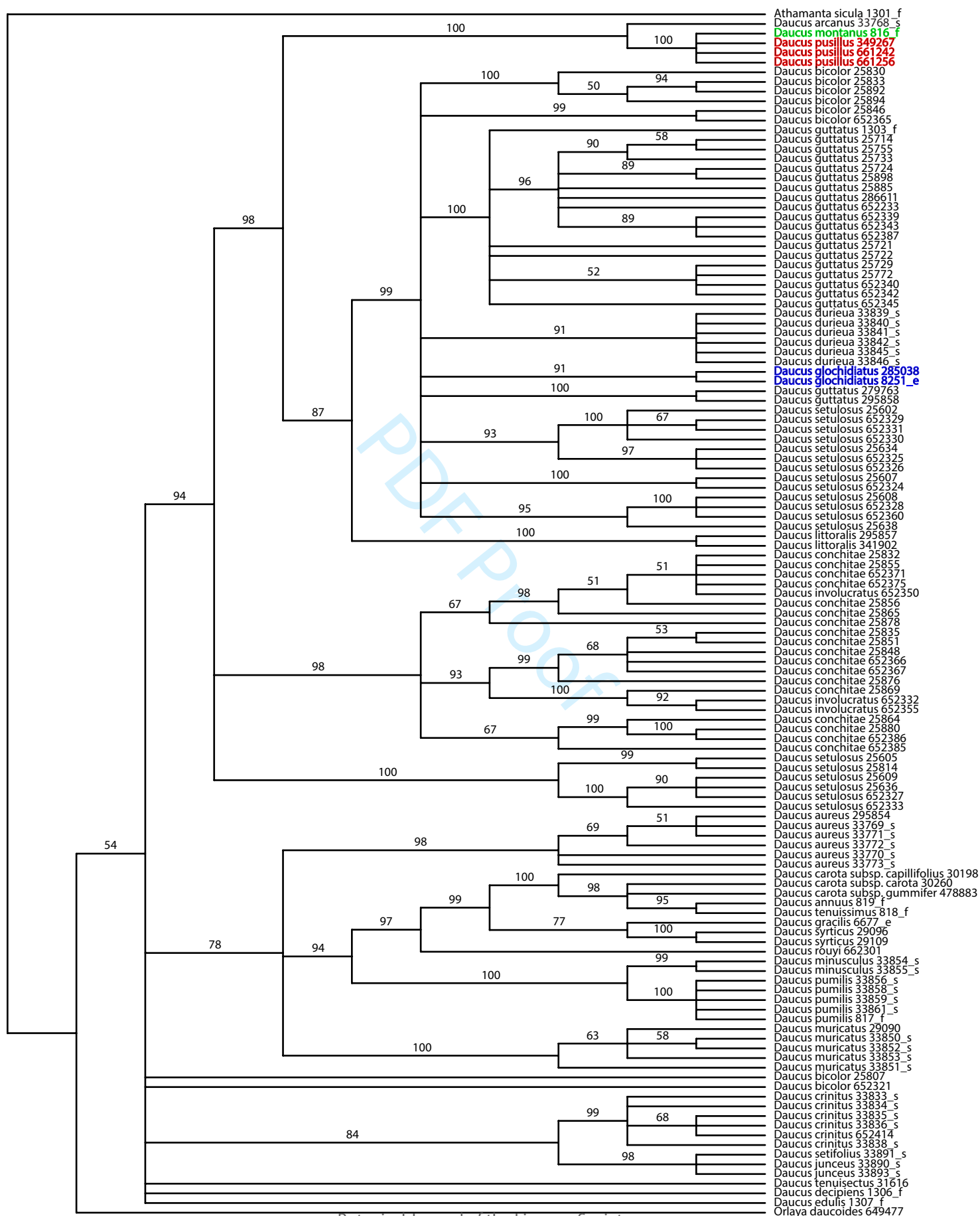
A set, 10966 allele, with *Daucus montanus*, bootstrap consensus tree



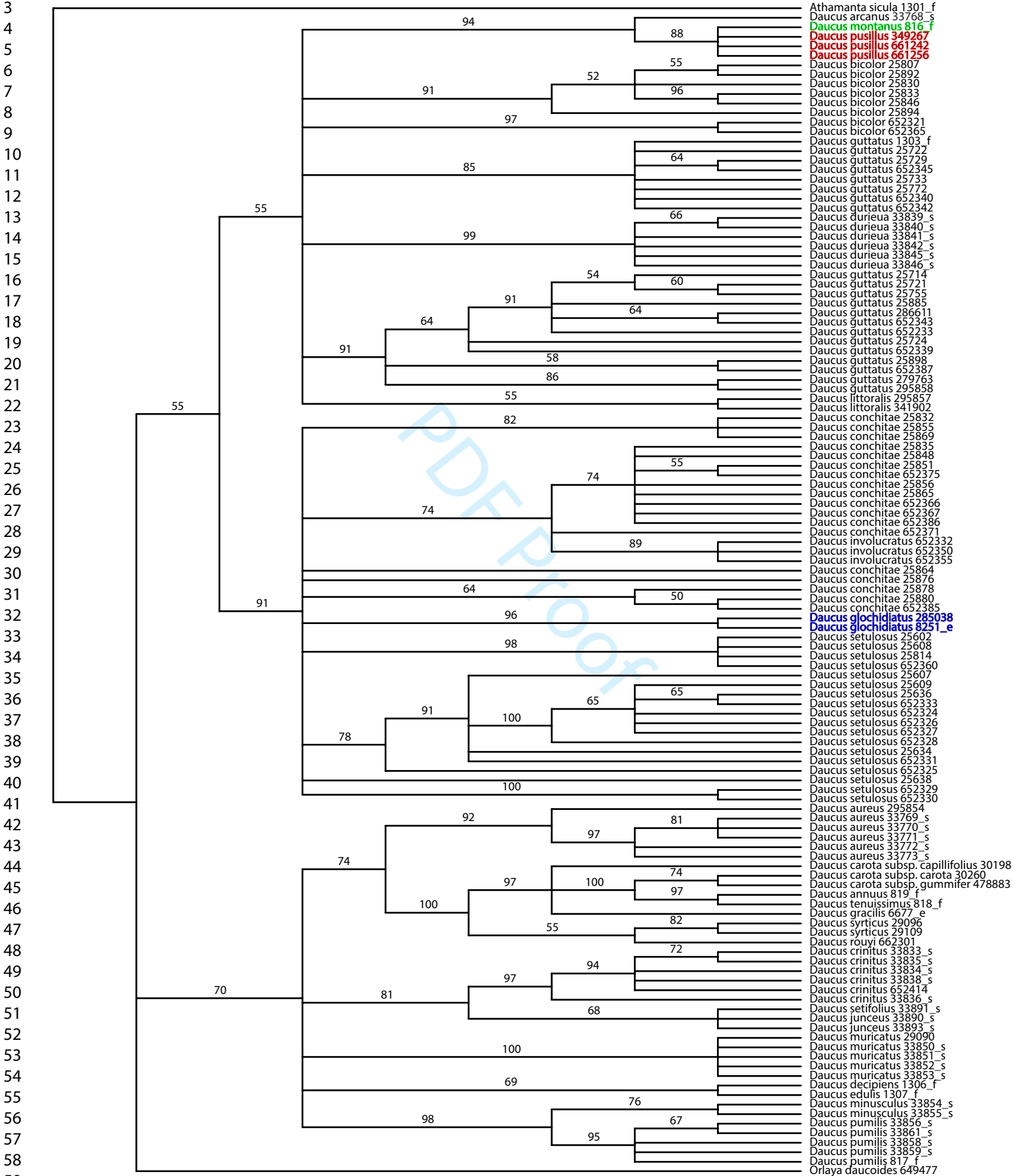
A set, 15347 allele, *Daucus montanus* missing, bootstrap consensus tree



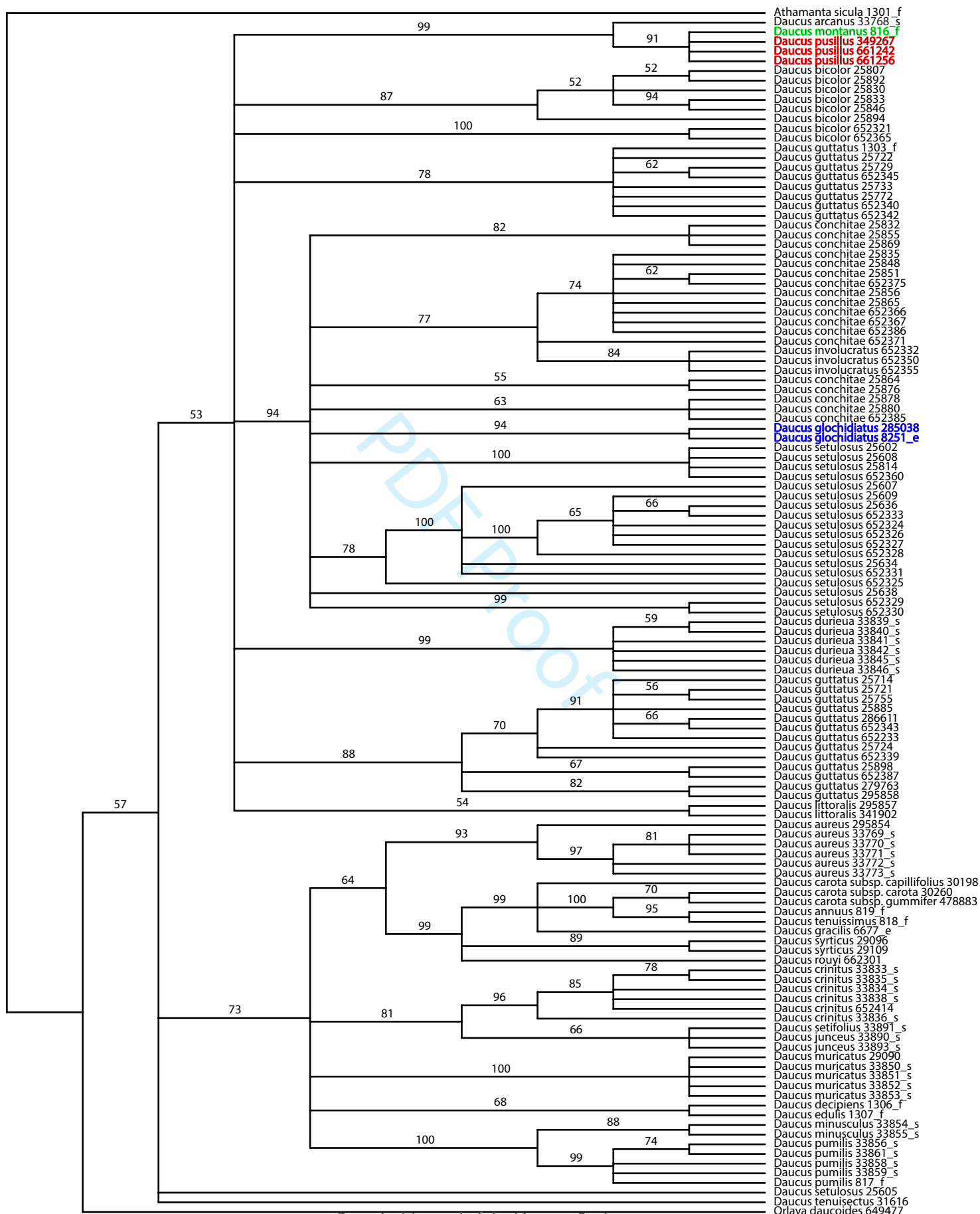
A set, 16038 allele, with *Daucus montanus*, bootstrap consensus tree



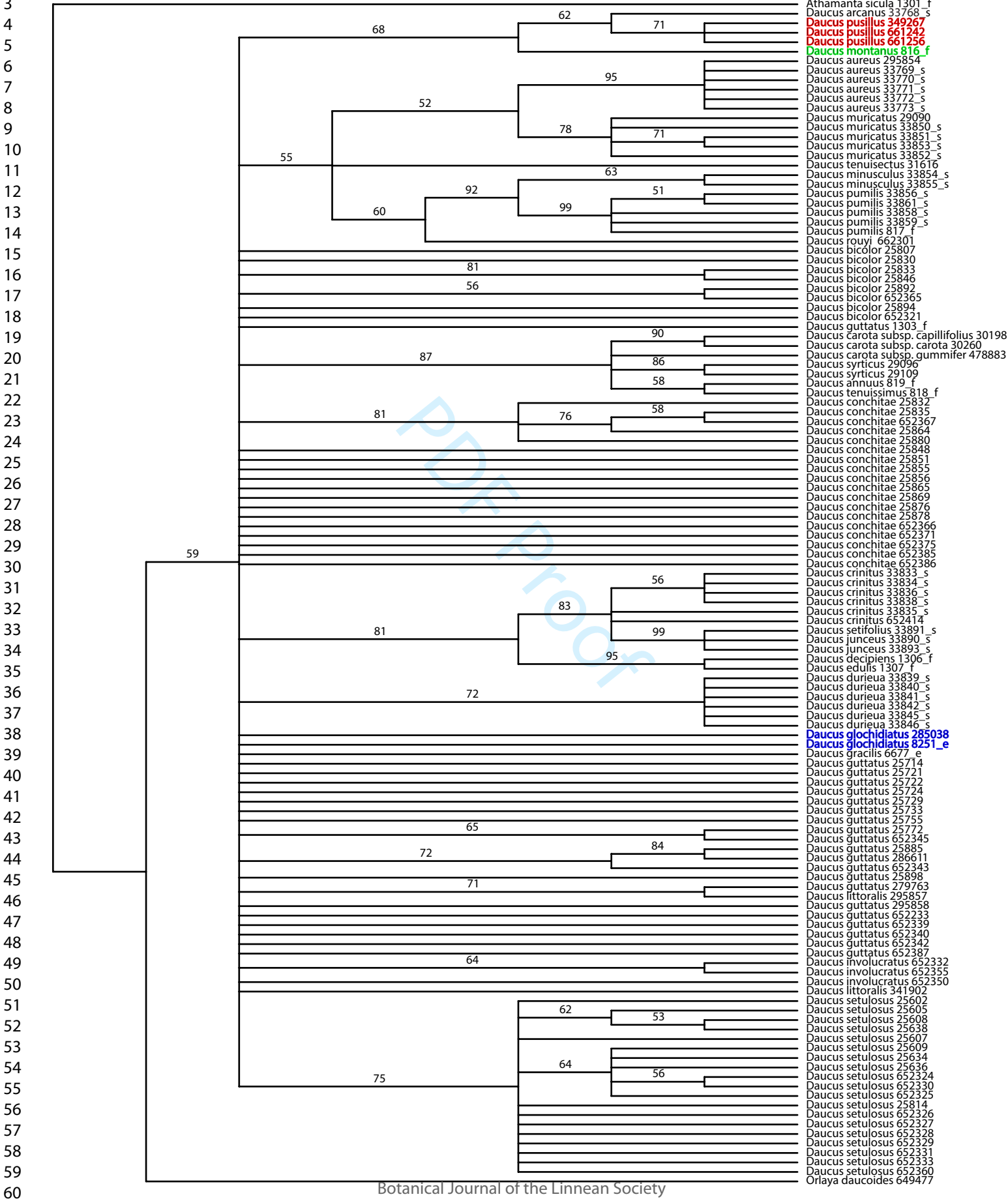
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2 A set, 16577 allele, with *Daucus montanus*, bootstrap consensus tree



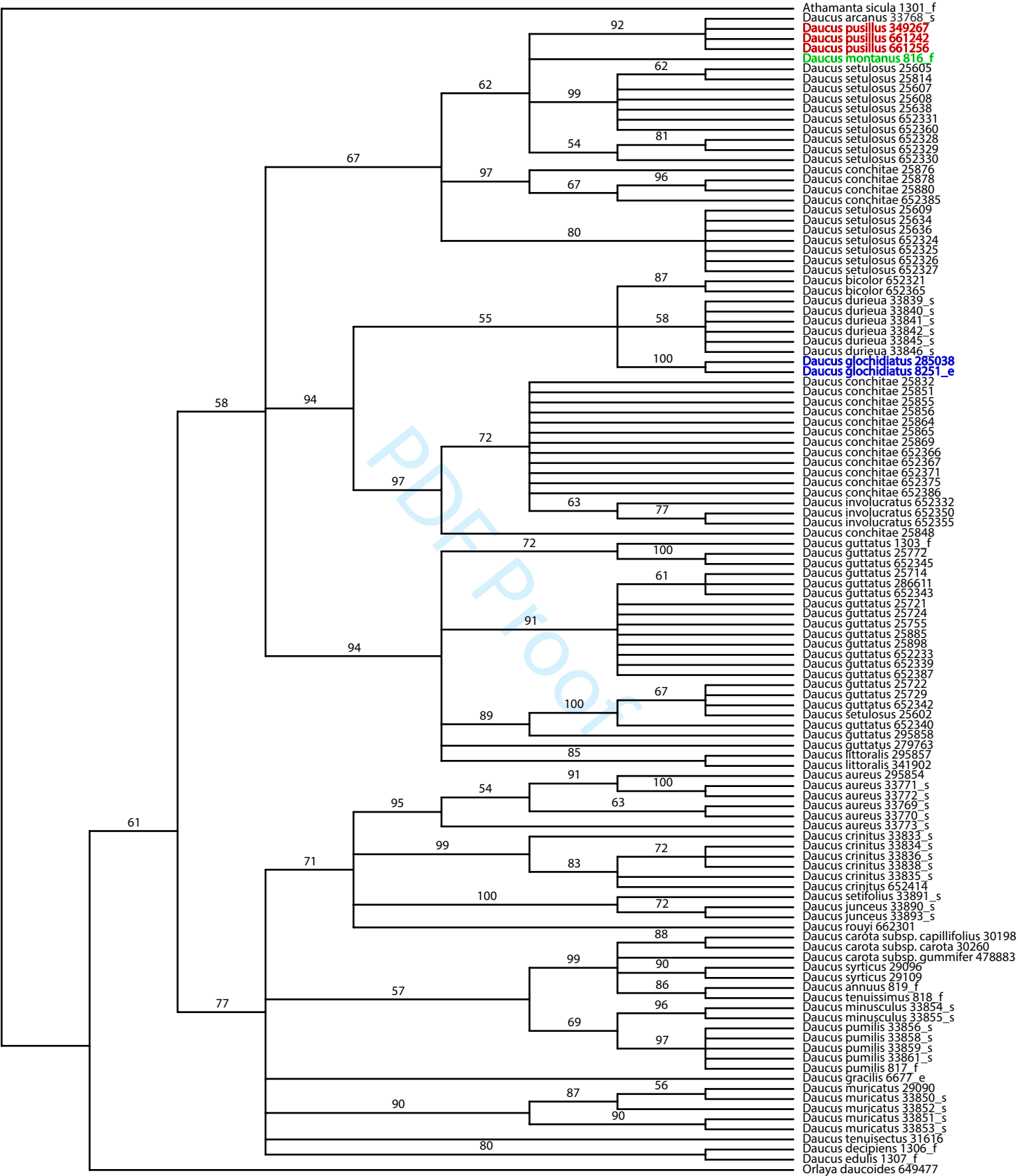
A set, 16645 allele, with *Daucus montanus*, bootstrap consensus tree



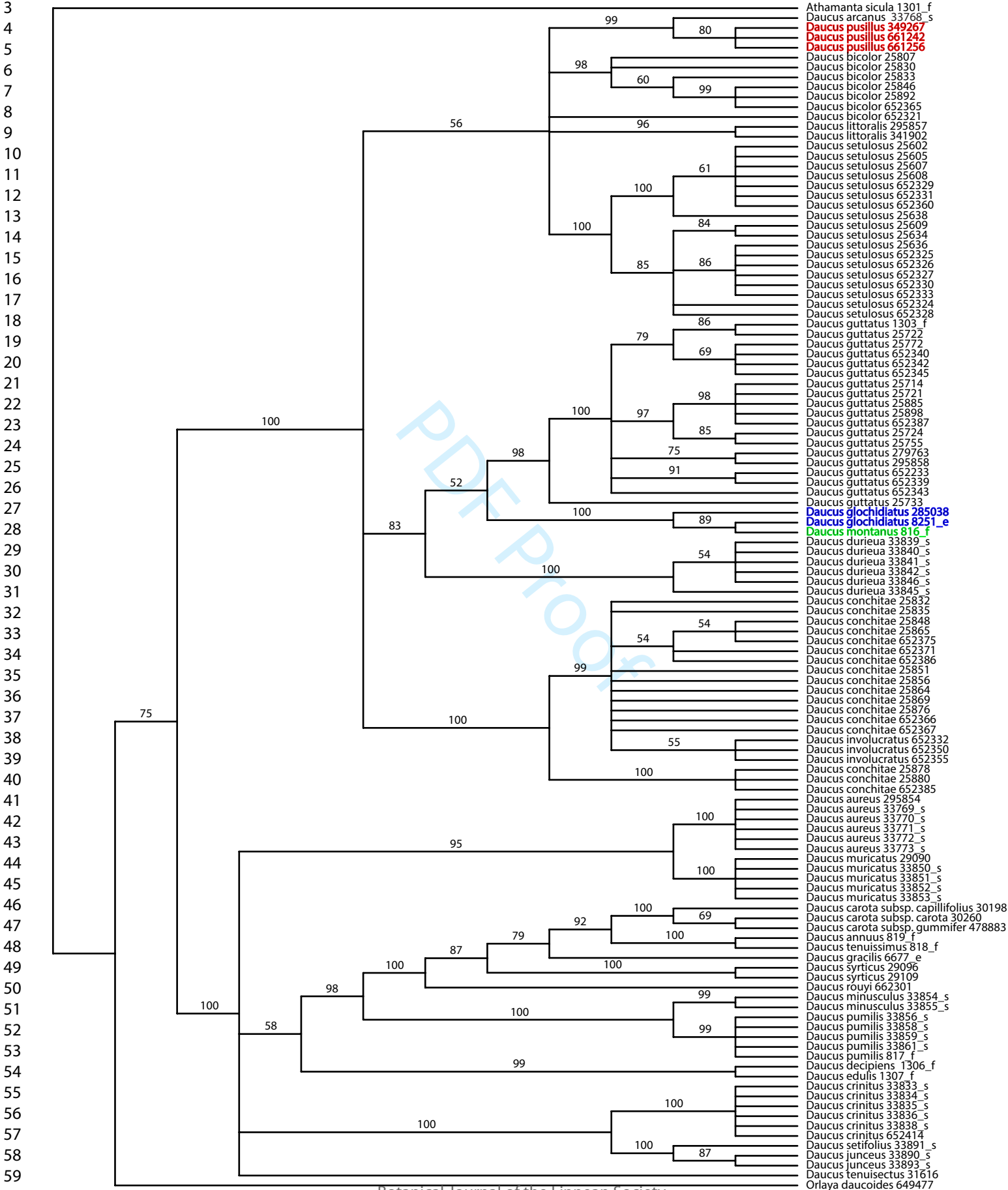
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2 A set, 32914 allele, with *Daucus montanus*, bootstrap consensus tree



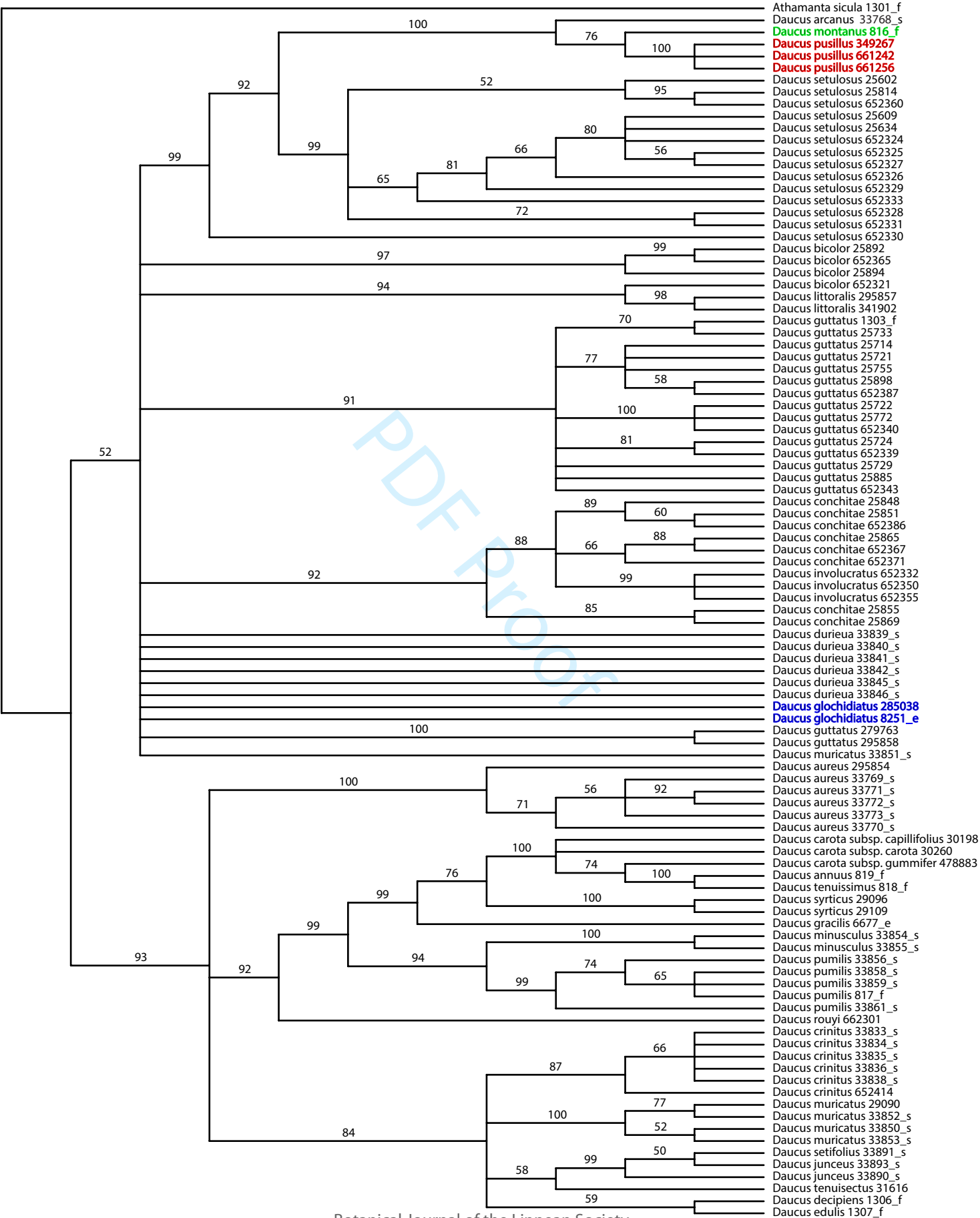
A set, 35097 allele, with *D. montanus*, bootstrap consensus tree



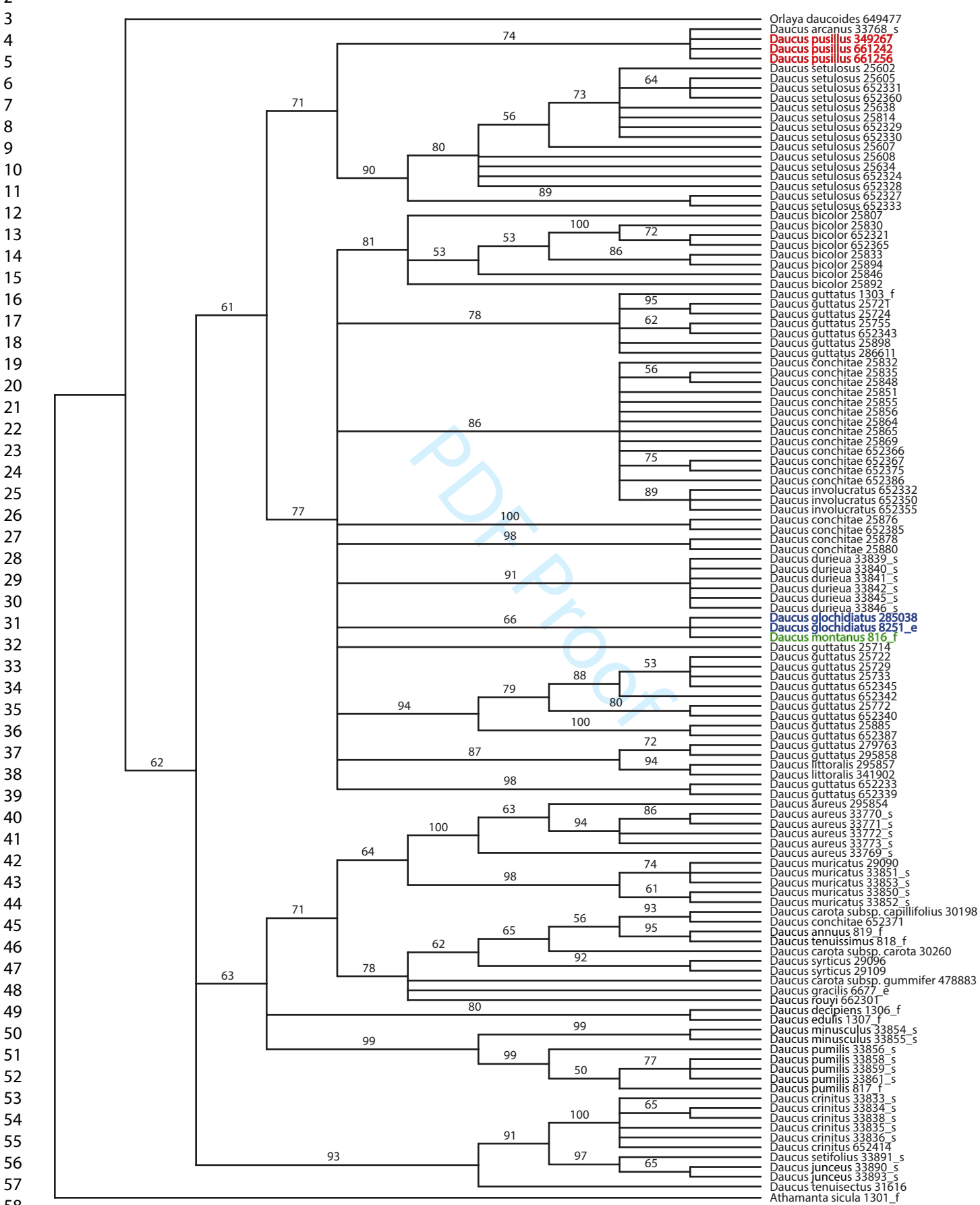
1
2 B set, 3374 allele, with *Daucus montanus*, bootstrap consensus tree



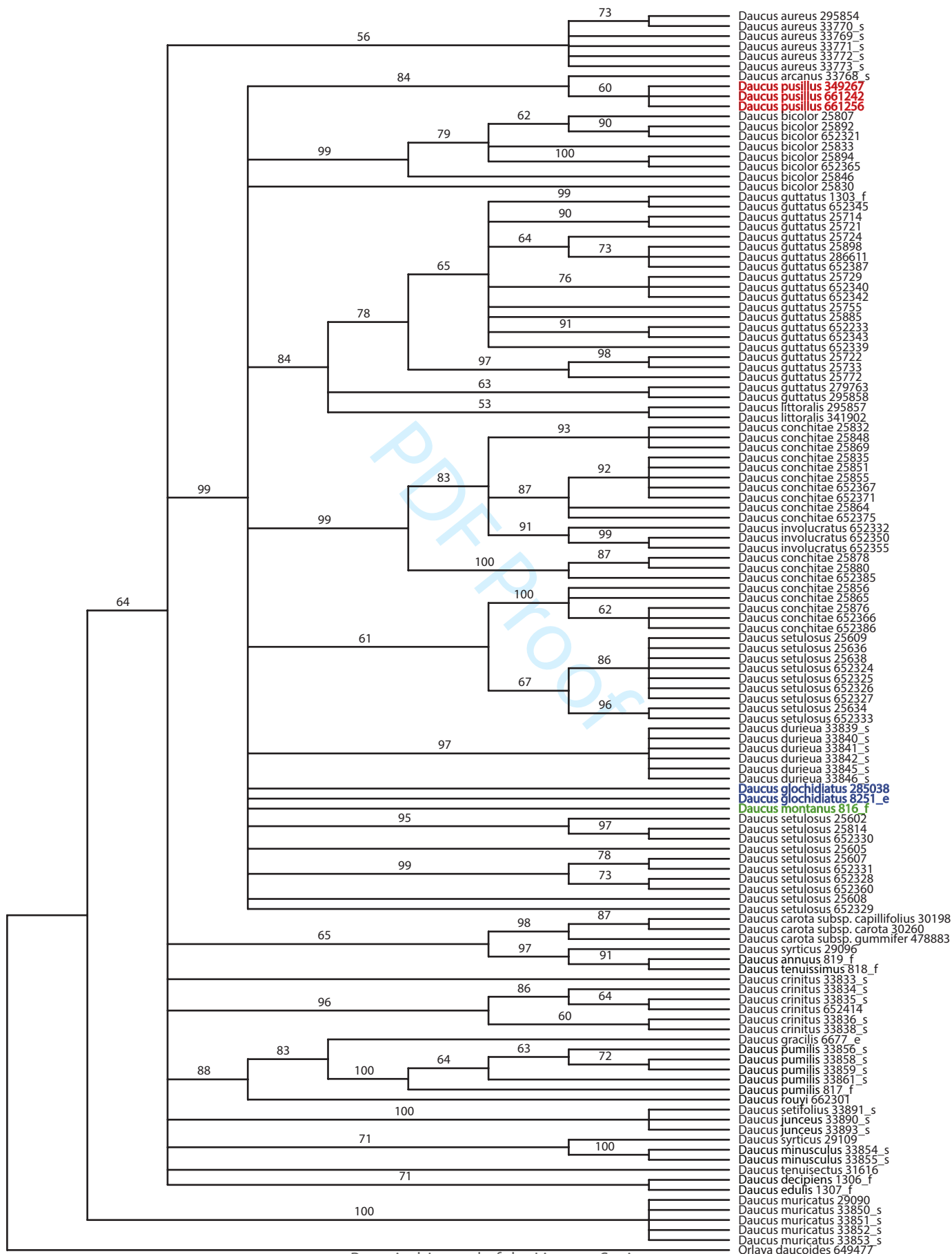
B set, 3902 allele, with *Daucus montanus*, bootstrap consensus tree



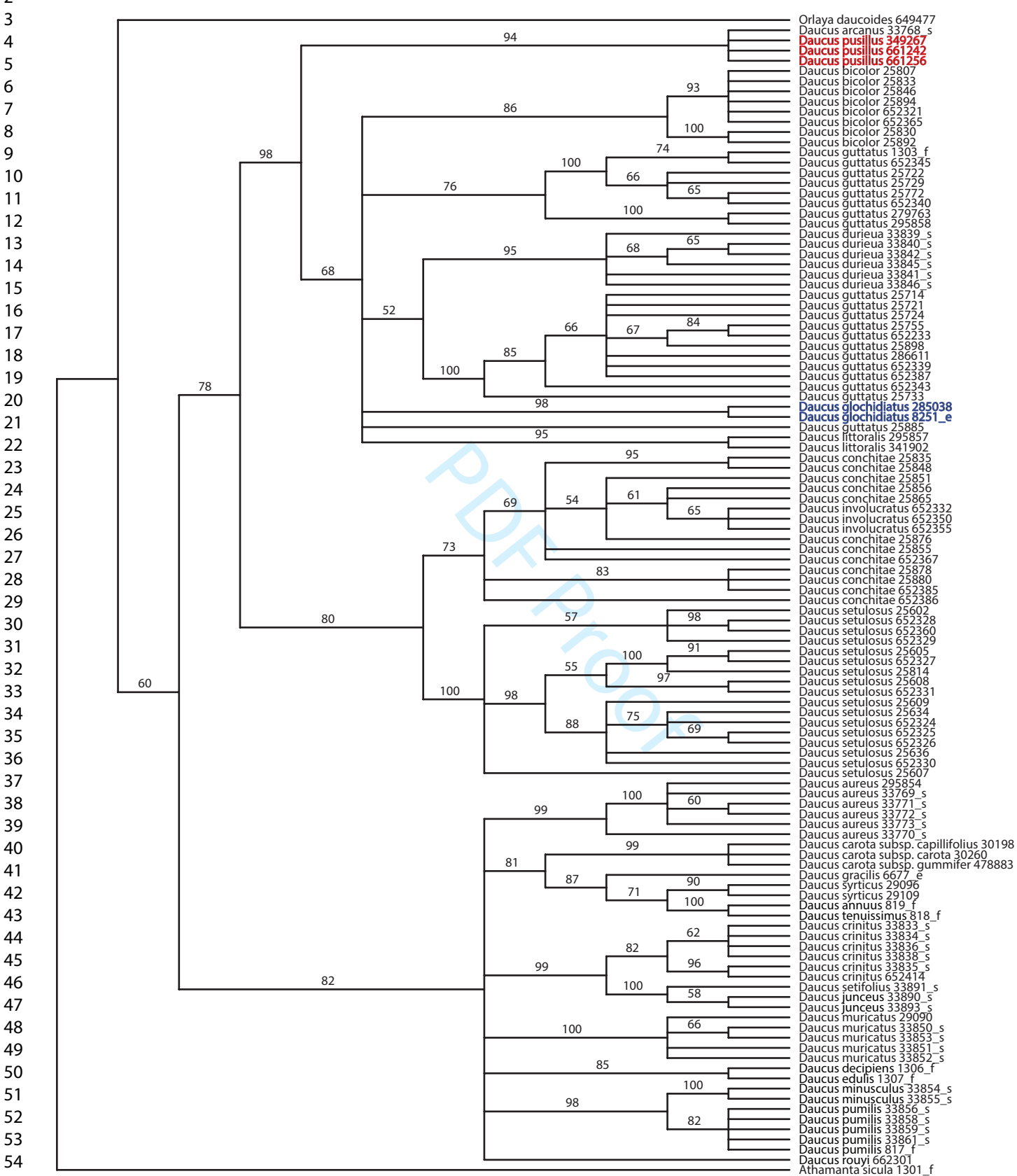
1
2 B set, 10366 allele, with *Daucus montanus*, bootstrap consensus tree



B set, 10966 allele, with *Daucus montanus*, bootstrap consensus tree

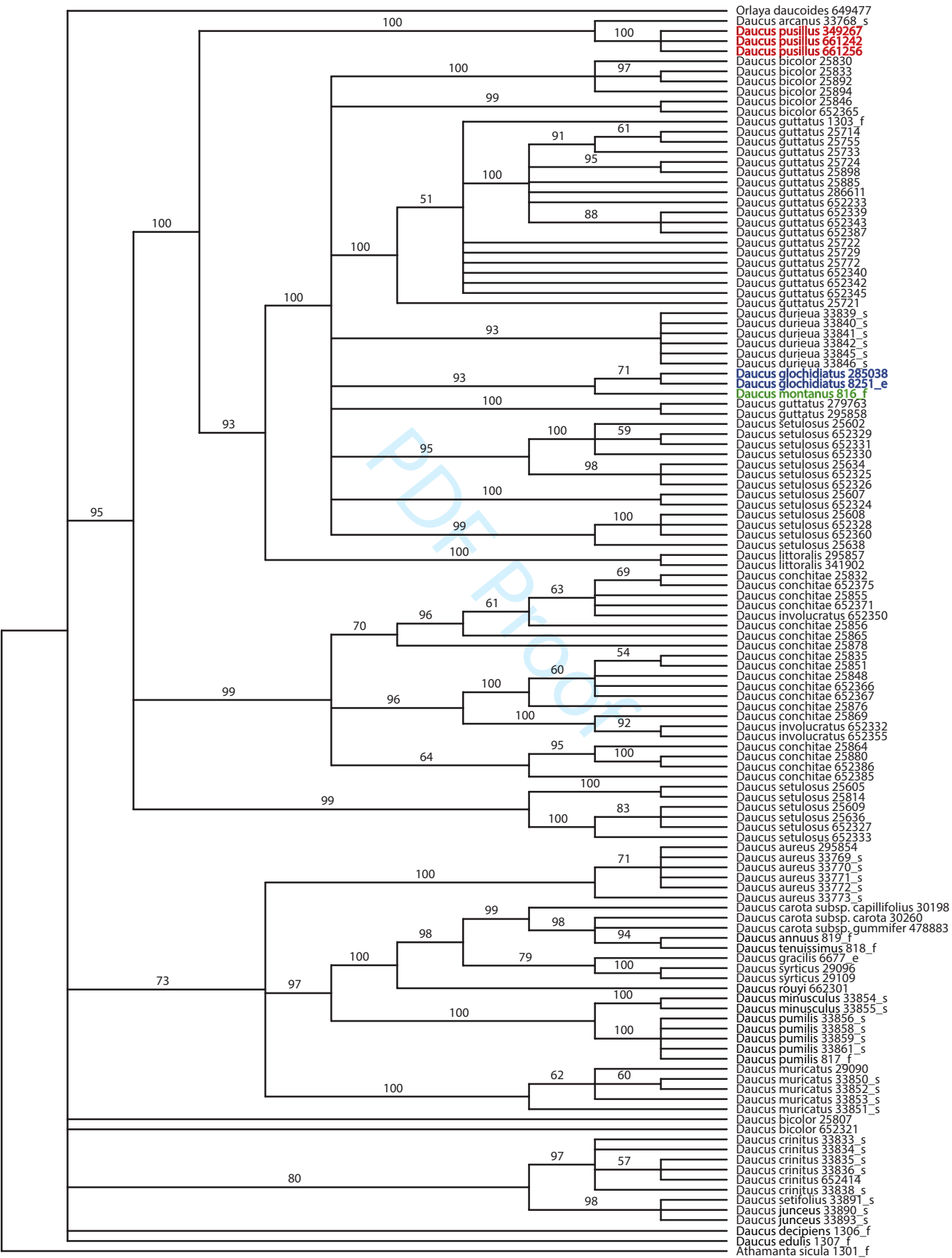


1
2 B set, 15347 allele, with *Daucus montanus*, bootstrap consensus tree



Orlaya daucoides 649477
Daucus arcanus 33768_s
Daucus pusillus 349267
Daucus pusillus 661242
Daucus pusillus 661256
Daucus bicolor 25830
Daucus bicolor 25833
Daucus bicolor 25892
Daucus bicolor 25894
Daucus bicolor 25846
Daucus bicolor 652365
Daucus guttatus 1303_f
Daucus guttatus 25714
Daucus guttatus 25755
Daucus guttatus 25733
Daucus guttatus 25724
Daucus guttatus 25898
Daucus guttatus 25885
Daucus guttatus 286611
Daucus guttatus 652233
Daucus guttatus 652339
Daucus guttatus 652343
Daucus guttatus 652387
Daucus guttatus 25722
Daucus guttatus 25729
Daucus guttatus 25772
Daucus guttatus 652340
Daucus guttatus 652342
Daucus guttatus 652345
Daucus guttatus 25721
Daucus durieua 33839_s
Daucus durieua 33840_s
Daucus durieua 33841_s
Daucus durieua 33842_s
Daucus durieua 33846_s
Daucus durieua 33845_s
Daucus glochidiatus 285038
Daucus glochidiatus 8251_e
Daucus montanus 816
Daucus guttatus 279763
Daucus guttatus 295858
Daucus setulosus 25602
Daucus setulosus 652329
Daucus setulosus 652331
Daucus setulosus 652330
Daucus setulosus 25634
Daucus setulosus 652325
Daucus setulosus 652326
Daucus setulosus 25607
Daucus setulosus 652324
Daucus setulosus 25608
Daucus setulosus 652328
Daucus setulosus 652360
Daucus setulosus 25638
Daucus littoralis 295857
Daucus littoralis 341902
Daucus conchitae 25832
Daucus conchitae 652375
Daucus conchitae 25855
Daucus conchitae 652371
Daucus involucratu 652350
Daucus conchitae 25856
Daucus conchitae 25865
Daucus conchitae 25878
Daucus conchitae 25835
Daucus conchitae 25851
Daucus conchitae 25848
Daucus conchitae 652366
Daucus conchitae 652367
Daucus conchitae 25876
Daucus conchitae 25869
Daucus involucratu 652332
Daucus involucratu 652355
Daucus conchitae 25864
Daucus conchitae 25880
Daucus conchitae 652386
Daucus conchitae 652385
Daucus setulosus 25605
Daucus setulosus 25814
Daucus setulosus 25609
Daucus setulosus 25636
Daucus setulosus 652327
Daucus setulosus 652333
Daucus aureus 295854
Daucus aureus 33769_s
Daucus aureus 33770_s
Daucus aureus 33771_s
Daucus aureus 33772_s
Daucus aureus 33773_s
Daucus carota subsp. capillifolius 30198
Daucus carota subsp. carota 30260
Daucus annuus 819_f
Daucus tenuissimus 818_f
Daucus gracilis 6677_e
Daucus syrticus 29096
Daucus syrticus 29109
Daucus rouyi 662301
Daucus minusculus 33854_s
Daucus minusculus 33855_s
Daucus pumilis 33856_s
Daucus pumilis 33858_s
Daucus pumilis 33859_s
Daucus pumilis 33861_s
Daucus pumilis 817_f
Daucus muricatus 29090
Daucus muricatus 33850_s
Daucus muricatus 33852_s
Daucus muricatus 33853_s
Daucus muricatus 33851_s
Daucus crinitus 33833_s
Daucus crinitus 33834_s
Daucus crinitus 33835_s
Daucus crinitus 33836_s
Daucus crinitus 652414
Daucus crinitus 33838_s
Daucus setifolius 3389_s
Daucus junceus 33890_s
Daucus junceus 33893_s
Daucus decipiens 1306_f
Daucus edulis 1307_f
Athamanta sicula 1301_f

B set, 16577 allele, with *Daucus montanus*, bootstrap consensus tree

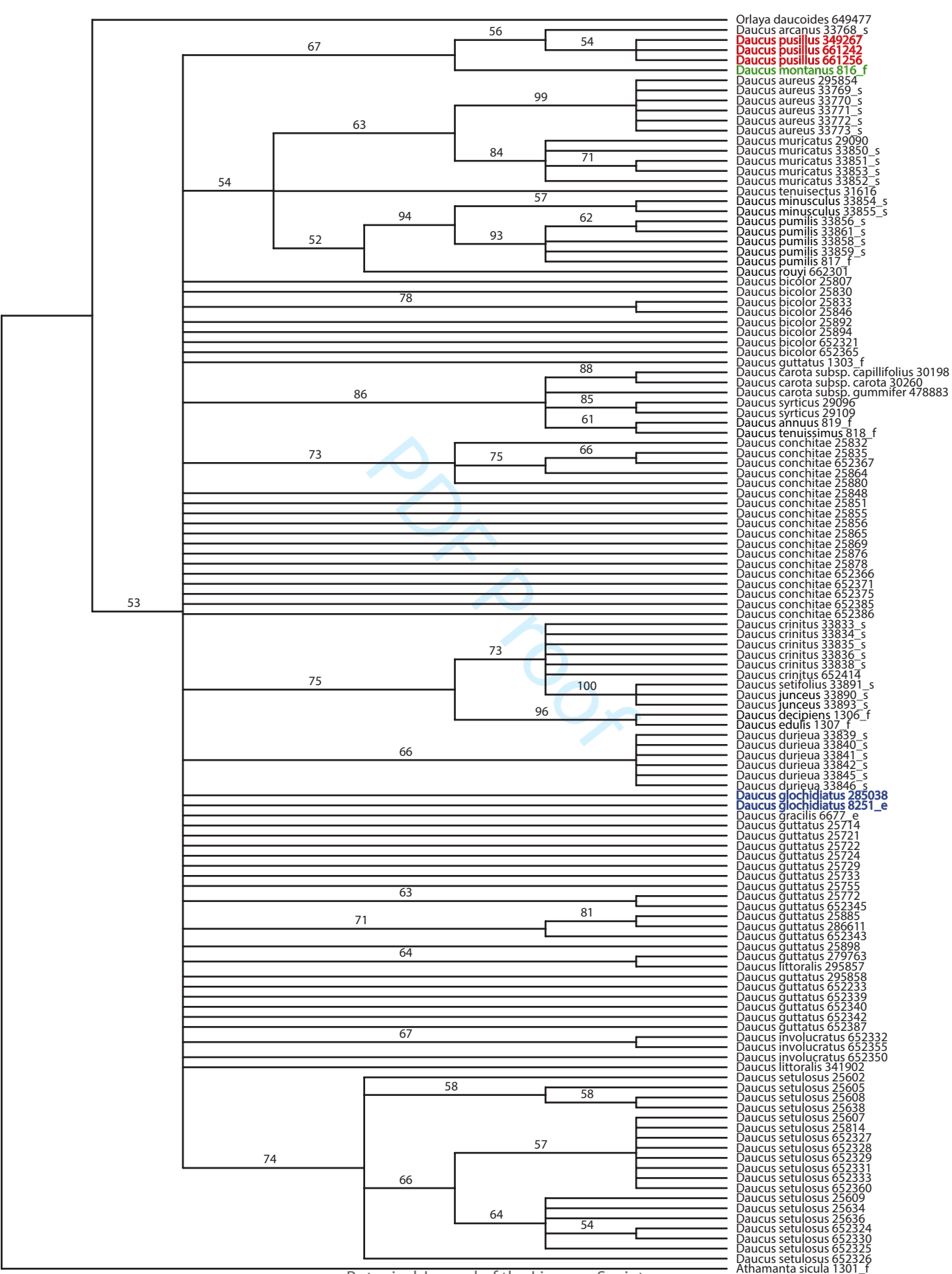


Phylogenetic tree showing relationships among various species, primarily from the genus *Daucus*. The tree is rooted on the left and branches to the right. Bootstrap values are indicated at the nodes. The species names are listed on the right, with some highlighted in red and others in green. The tree is divided into several major clades, including *Daucus* and *Orlavia*.

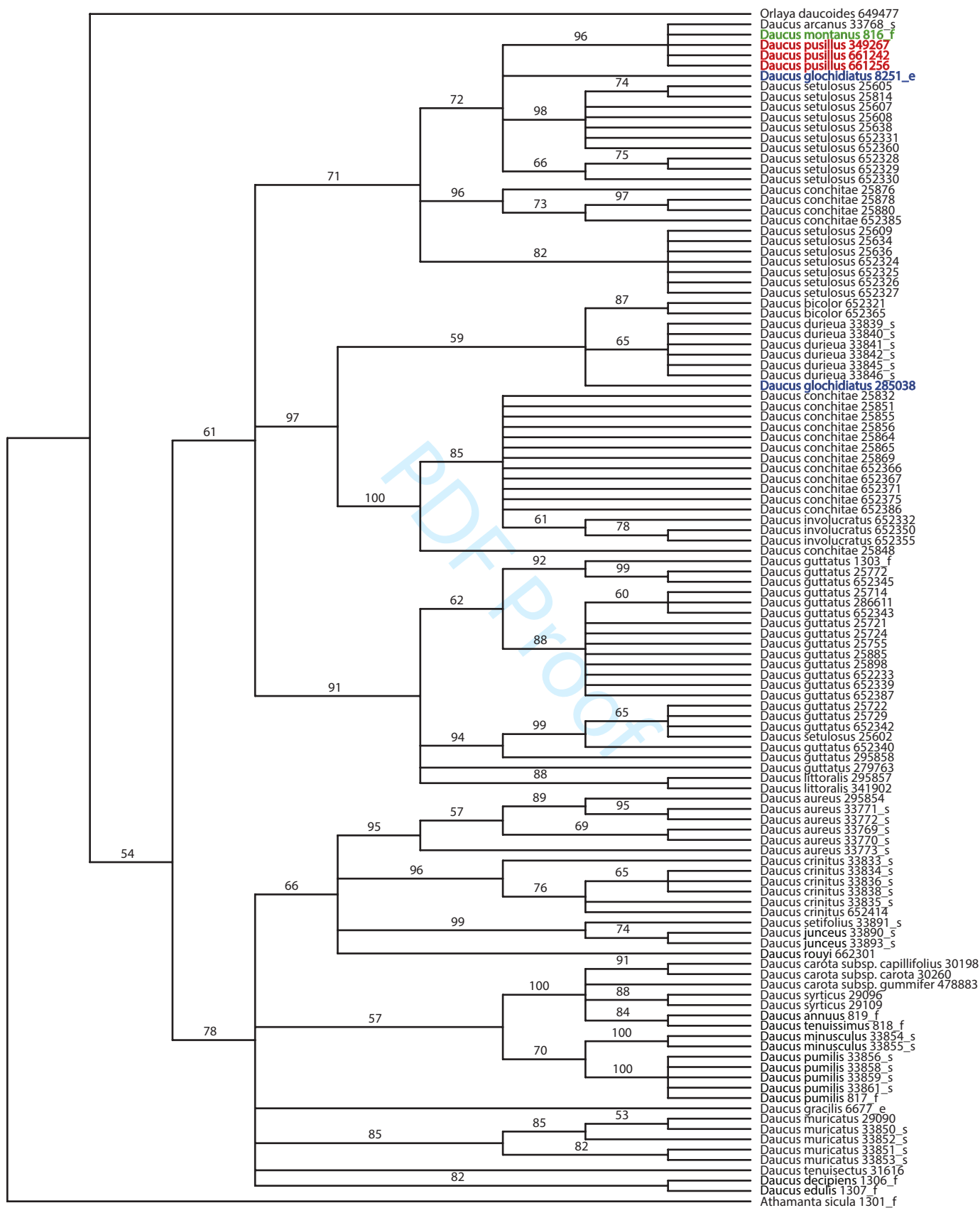
Species names (from top to bottom):

- Daucus arcuatus* 1301 f
- Daucus arcuatus* 33768 s
- Daucus pusillus* 349267
- Daucus pusillus* 661242
- Daucus pusillus* 661256
- Daucus setulosus* 25608
- Daucus setulosus* 25814
- Daucus bicolor* 25807
- Daucus bicolor* 25830
- Daucus bicolor* 25833
- Daucus bicolor* 25894
- Daucus bicolor* 25846
- Daucus bicolor* 25892
- Daucus bicolor* 652321
- Daucus bicolor* 652365
- Daucus conchitae* 25832
- Daucus conchitae* 25851
- Daucus conchitae* 25864
- Daucus conchitae* 25869
- Daucus conchitae* 25876
- Daucus conchitae* 652366
- Daucus conchitae* 25856
- Daucus conchitae* 652335
- Daucus conchitae* 25865
- Daucus conchitae* 652375
- Daucus conchitae* 652386
- Daucus conchitae* 25880
- Daucus conchitae* 25835
- Daucus involucratum* 652332
- Daucus involucratum* 652350
- Daucus involucratum* 652355
- Daucus conchitae* 25848
- Daucus conchitae* 25855
- Daucus conchitae* 652367
- Daucus conchitae* 652371
- Daucus conchitae* 25878
- Daucus setulosus* 25602
- Daucus setulosus* 25605
- Daucus setulosus* 25638
- Daucus setulosus* 652329
- Daucus setulosus* 652331
- Daucus setulosus* 652360
- Daucus setulosus* 25607
- Daucus setulosus* 25609
- Daucus setulosus* 25636
- Daucus setulosus* 25634
- Daucus setulosus* 652325
- Daucus setulosus* 652327
- Daucus setulosus* 652326
- Daucus setulosus* 652324
- Daucus setulosus* 652333
- Daucus setulosus* 652328
- Daucus setulosus* 652330
- Daucus guttatus* 1303 f
- Daucus guttatus* 25772
- Daucus guttatus* 25732
- Daucus guttatus* 25722
- Daucus guttatus* 25733
- Daucus guttatus* 25772
- Daucus guttatus* 652340
- Daucus guttatus* 652345
- Daucus guttatus* 25898
- Daucus guttatus* 652233
- Daucus guttatus* 652339
- Daucus durieua* 33839 s
- Daucus durieua* 33841 s
- Daucus durieua* 33842 s
- Daucus durieua* 33845 s
- Daucus durieua* 33840 s
- Daucus durieua* 33846 s
- Daucus glochidiatus* 285038
- Daucus glochidiatus* 8251_e
- Daucus montanus* 816 f
- Daucus guttatus* 25714
- Daucus guttatus* 25721
- Daucus guttatus* 25724
- Daucus guttatus* 25735
- Daucus guttatus* 286611
- Daucus guttatus* 652387
- Daucus guttatus* 25885
- Daucus guttatus* 652343
- Daucus guttatus* 279763
- Daucus guttatus* 295858
- Daucus littoralis* 295857
- Daucus littoralis* 341902
- Daucus aureus* 295854
- Daucus aureus* 33769 s
- Daucus aureus* 33771 s
- Daucus aureus* 33770 s
- Daucus aureus* 33772 s
- Daucus aureus* 33773 s
- Daucus carota* subsp. *capillifolius* 30198
- Daucus carota* subsp. *gummifer* 478883
- Daucus carota* subsp. *carota* 30260
- Daucus syrticus* 29096
- Daucus syrticus* 29109
- Daucus annuus* 819 f
- Daucus tenuissimus* 818 f
- Daucus minusculus* 33854_s
- Daucus pumilus* 33866_s
- Daucus pumilus* 33858_s
- Daucus pumilus* 33861_s
- Daucus pumilus* 817 f
- Daucus minusculus* 33855_s
- Daucus pumilus* 33859_s
- Daucus rouyi* 662301
- Daucus crinitus* 33833_s
- Daucus crinitus* 33834_s
- Daucus crinitus* 33835_s
- Daucus crinitus* 33836_s
- Daucus crinitus* 652414
- Daucus crinitus* 652414
- Daucus setifolius* 33891_s
- Daucus junceus* 33890_s
- Daucus junceus* 33893_s
- Daucus gracilis* 6677_e
- Daucus decipiens* 1306_f
- Daucus edulis* 1307_f
- Daucus muricatus* 29090
- Daucus muricatus* 33852_s
- Daucus muricatus* 33850_s
- Daucus muricatus* 33853_s
- Daucus muricatus* 33851_s
- Daucus tenuisectus* 31616
- Orlavia daucoides* 649477

B set, 32914 allele, with *Daucus montanus*, bootstrap consensus tree

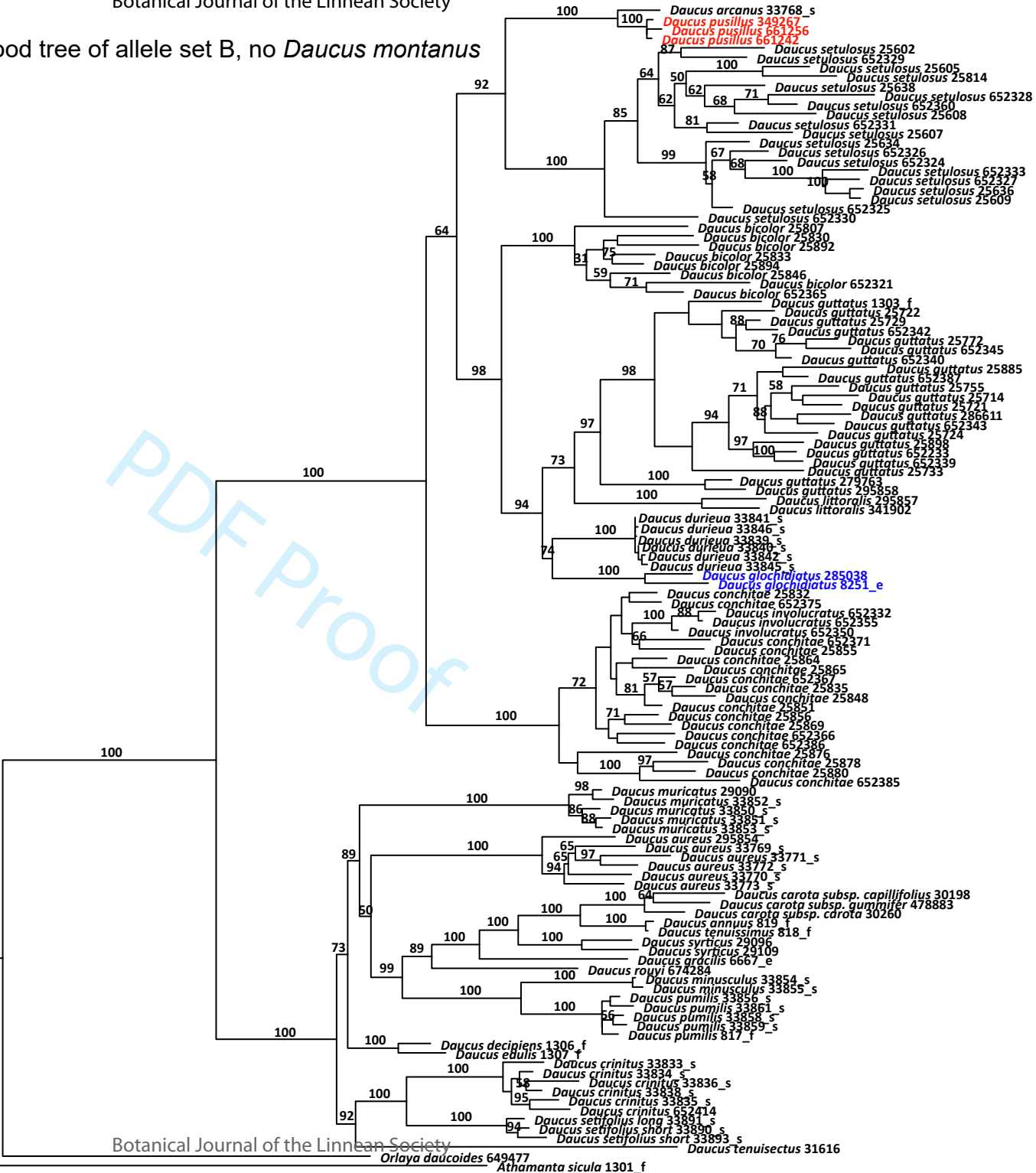


B set, 35097 allele, with *Daucus montanus*, bootstrap consensus tree



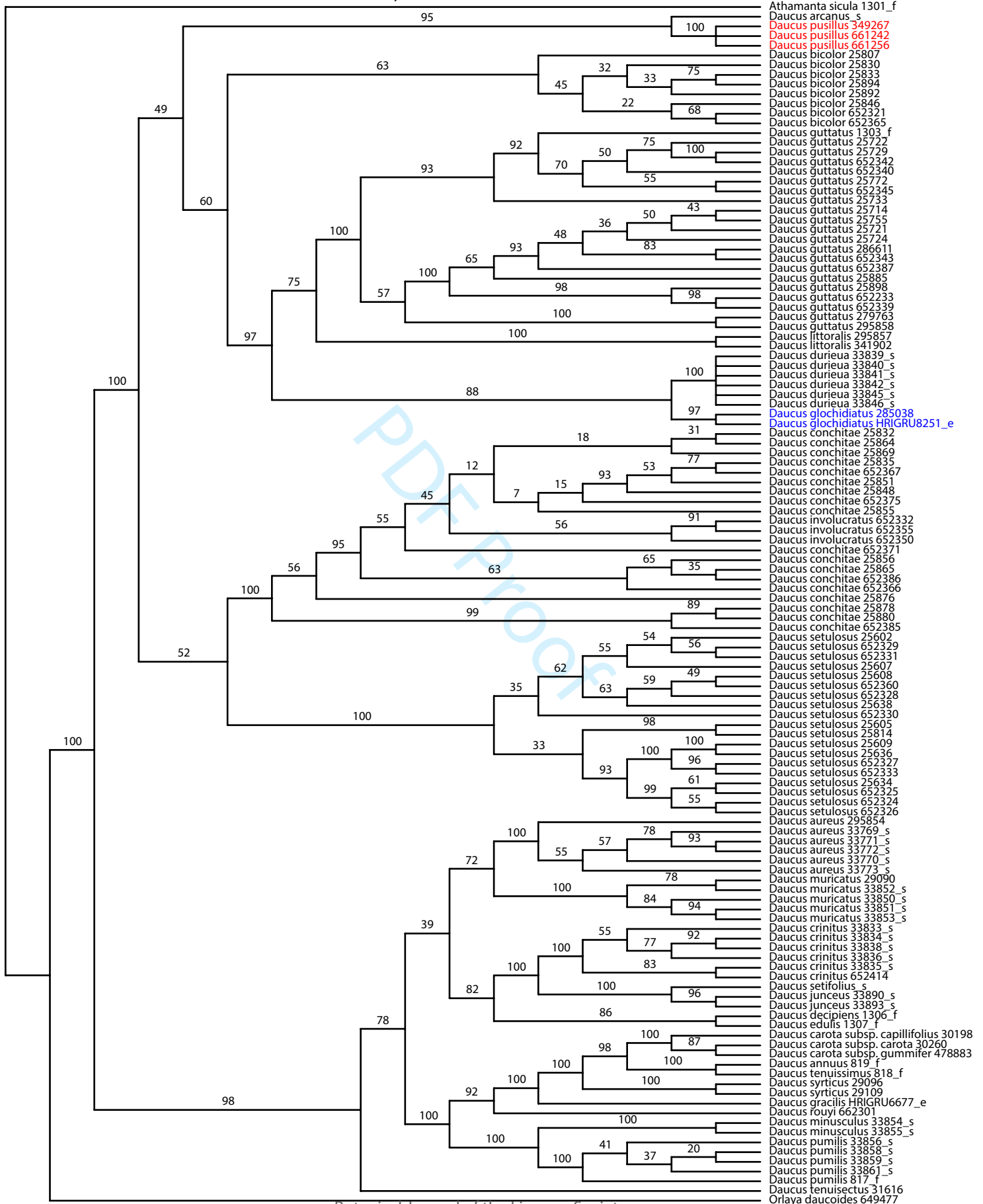
Supplemental file 6. Maximum likelihood tree of allele set B, no *Daucus montanus*

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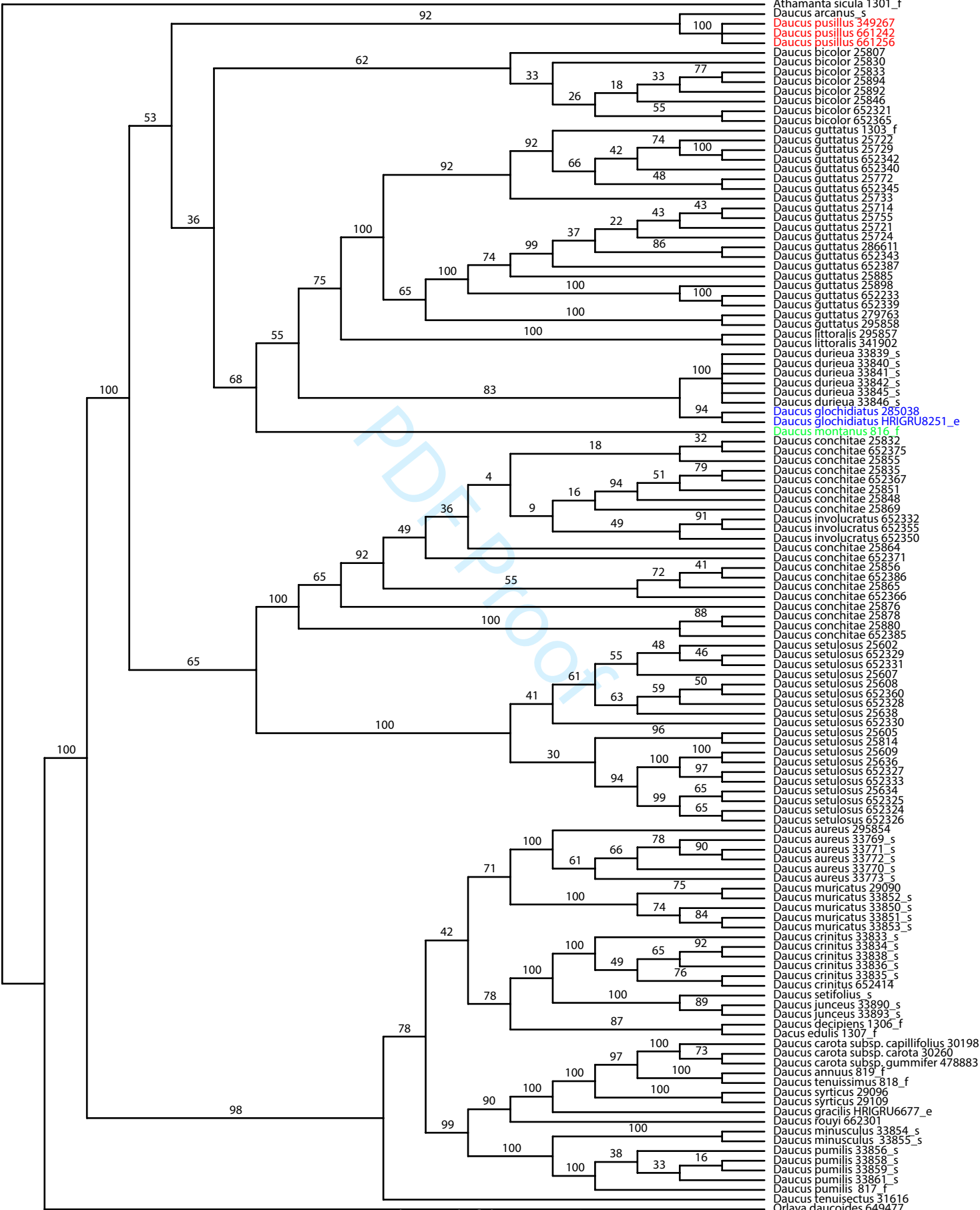
Supplementary file 7. The allele set A and B SVD trees with and without *D. montanus* and allele set B with *D. montanus*.

This tree A set, without *Daucus montanus*



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A set, with *Daucus montanus*



B set, with *Daucus montanus*